Grass genera of Western Canadian cattle rangelands

Cover photo: Looking west to the Rocky Mountains from Agriculture Canada's Stavely Substation in the Porcupine Hills of Alberta. In the foreground is an ungrazed test plot dominated by the grass genera *Festuca*, *Stipa*, and *Agropyron*.

Grass genera of Western Canadian cattle rangelands

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Agriculture Canada

Monograph No. 29
1983

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Available in Canada through

Authorized Bookstore Agents
and other bookstores

or by mail from

Canadian Government Publishing Centre
Supply and Services Canada
Ottawa, Canada K1A 0S9

Catalogue No. A 54-3/29E
ISBN 0-660-11386-4

Canada: $9.00
Other countries: $10.80

Price subject to change without notice

Canadian Cataloguing in Publication Data

Aiken, S. G.

Grass genera of western Canadian cattle rangelands

(Monograph ; no. 29)

Includes bibliographical references and index.

1. Grasses — Canada, Western — Classification. I. Darbyshire, S. J. II. Canada. Agriculture Canada. Research Branch. III. Title. IV. Series: Monograph (Canada. Agriculture Canada) ; no. 29.

QK495.G74A34 584'.9'09712 C83-097202-1

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Acknowledgments

The authors wish to thank B. M. Brooke, A. McLean, and R. E. Tucker (Agriculture Research Station, Kamloops, B.C.), J. R. Allan and S. Smoliak (Agriculture Research Station, Lethbridge, Alta.), J. Looman (Agriculture Research Station, Swift Current, Sask.), V. L. Harms (University of Saskatchewan, Saskatoon), and M. D. Fairbarns (Alberta Parks, Planning) for assistance in field work; J. M. Gillett (National Museums of Canada, Ottawa) for permission to examine specimens in the National Herbarium; H. T. Clifford for helpful suggestions in the development of a character list applicable to Western Canadian cattle rangelands; J. D. Hobbs for help in using the Dallwitz KEY computer program with the data; S. E. Aitken (S.E.A.) for drawing most of the figures; A. Hanes for figures that had been drawn by her for another purpose and were skillfully modified for use in this publication by A. J. Lutes, who also produced the map; C. Beddoe for taking the photographs used in the lodicule plate (Fig. 5); P. M. Catling, W. J. Cody, J. McNeill, and E. Small for reading the manuscript and suggesting improvements; and S. V. Balchin for her most significant editorial contribution.

Introduction

Choice of taxa

Most floristic works dealing with Canadian grasses have followed the classification and the generic concepts of Hitchcock and Chase (1951) *Manual of the grasses of the United States.* Publications such as Scoggan (1957, 1978), Looman and Best (1979), and Dore and McNeill (1980) follow that work relatively closely, probably because their preparation was begun shortly after this classic manual appeared. Since then, considerable taxonomic research has been done and many new ideas on generic limits have been presented. Gould (1968) adopted a classification that arranges genera in tribes that are rather different from those recognized by Hitchcock and Chase; Gould's treatment has become widely accepted.

Gould's circumscriptions of grass genera have been assessed and in most instances his findings have been adopted here. In a few situations we have suggested the generic concepts used by Tzvelev (1976) in his treatment of the grasses of the Soviet Union, or by Tutin et al. (1980) in *Flora Europaea,* because several of the grasses native to temperate Eurasia have been introduced into Canada and some have become well established as range species.

There are several publications that are useful in studying grass species in Western Canada; for example, Moss (1959), Scoggan (1957, 1978), Looman and Best (1979), Taylor and MacBryde (1977, 1978), and Boivin (1981). However, none of these makes any attempt to provide complete generic descriptions. Most of these works provide keys to the genera, but it is possible to have a specimen that lacks an essential keying character, or to misread the key, and not be able to confirm an apparent generic identification. Thus, a publication with detailed generic descriptions is a useful addition to existing literature.

In certain genera, particularly *Agropyron, Bromus, Festuca,* and *Poa,* there is considerable confusion as to which species are present in Western Canada, how they should be delimited, and which names are correct. Unraveling these problems will require considerable time and in some instances extensive research. Rather than delay publication for some years while this work is being undertaken, this monograph presents a classification of the grass genera in Western Canadian rangelands that incorporates recent taxonomic and nomenclatural research and includes preliminary lists of the species considered to be in these genera.

In almost all cases, the genera adopted by Gould (1968) have been used. Where other authorities have been followed, the reasons for doing so are explained following the generic description. Gould worked in Texas and his experience was mainly with the contiguous United States

and especially with grasses growing in warmer regions of the North American continent. There are Canadian genera and species that were not considered by him when he developed his generic descriptions. The present work is limited to the genera of grasses found in Western Canadian rangelands and the descriptions are based on the species present. This sometimes results in the omission of features characteristic of members of the genus found in other parts of the world.

Delimitation of area studied

The concept of Western Canadian rangelands is taken to include all grazing land west of the Ontario–Manitoba border. "Cattle" is used in the title to distinguish grasslands where these animals are currently grazed from wildlife rangelands used by undomesticated herbivores. The emphasis on cattle helps to delimit the northern and altitudinal boundaries of this study. In British Columbia there are 7 200 000 ha of forested rangeland; in these, the altitudinal limit that occurs between 2700 and 3000 m is clearly defined in some areas by a dense spruce–fir zone that has almost no grass flora and such dense tangled undergrowth that it is unsuitable for cattle.

Above this region, the grass flora of subalpine meadows is different from that of lower altitudes (Daubenmire 1943, Mueggler and Stewart 1980) and species restricted to these higher elevations are not included in this publication. The northern boundary of cattle rangelands is delimited in many areas by boreal forest, or a transition to subarctic grasslands in which the species composition is more similar to that in subalpine meadows than to that in other grass communities (personal communication, McLean and Roberts). "Rangeland" is defined following McLean and Marchand (1968) as "...an area that has potential for growing forage. The potential depends on the soil, climate and slope and is achieved by the climax plant community characteristic of the site." Much of the study area includes the many forms of grass-dominated native prairies, but the concept of rangeland also covers the millions of forested hectares in British Columbia where *Calamagrostis rubescens* is the dominant grass and where the Ministry of Forests in British Columbia employs rangeland managers.

An indication of the extent of Western Canadian cattle rangeland is given in Fig. 1, a map based on information in *The national atlas of Canada* (1974). In general, rangeland is delimited to the west by the mountain topography of British Columbia. To the north it is bounded by boreal forest, to the east by extensive areas of cultivation in Saskatchewan and Manitoba, and by the boreal and mixed forests near the Manitoba–Ontario border. The United States–Canadian border was taken as the southern limit in this work. McLean and Marchand (1968) have several excellent color photographs of the rangelands in British Columbia.

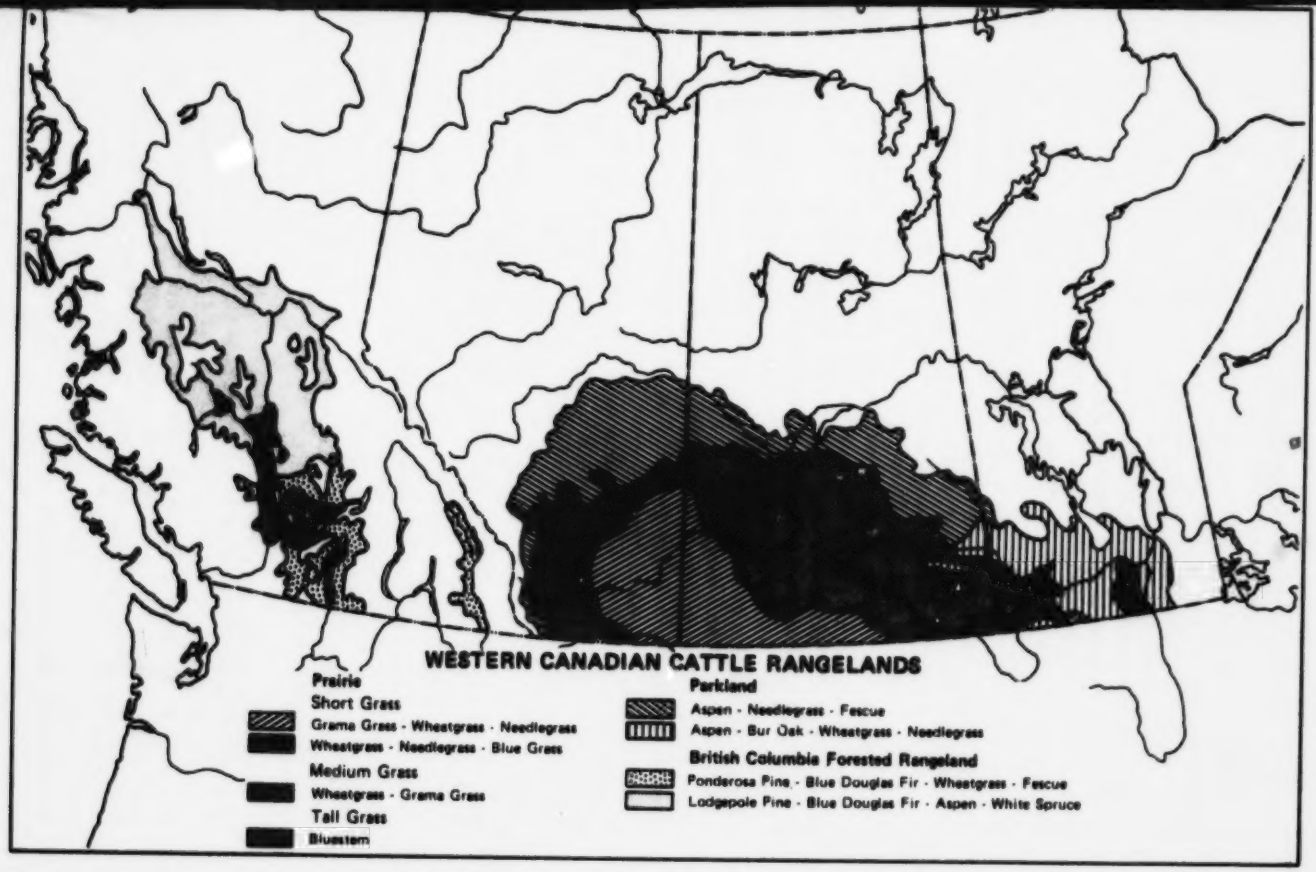
WESTERN CANADIAN CATTLE RANGELANDS
Prairie
Short Grass
Grama Grass - Wheatgrass - Needlegrass
Wheatgrass - Needlegrass - Blue Grass
Medium Grass
Wheatgrass - Grama Grass
Tall Grass
Bluestem
Parkland
Aspen - Needlegrass - Fescue
Aspen - Bur Oak - Wheatgrass - Needlegrass
British Columbia Forested Rangeland
Ponderosa Pine - Blue Douglas Fir - Wheatgrass - Fescue
Lodgepole Pine - Blue Douglas Fir - Aspen - White Spruce

Fig. 1. Western Canadian cattle rangelands. Map is based on information in *The national atlas of Canada* (1974), pp. 45–46.

Coupland (1950) has many photographs of the mixed prairie of Saskatchewan and southeastern Alberta; Smoliak et al. (1974) illustrate the different types of Alberta range pastures, including the short-grass prairie, dominated by *Stipa* and *Bouteloua*, wet meadow, and woodland pastures. Most of the tall-grass prairie that was dominant in southern Manitoba has been converted to cropland. A small portion is preserved as the Living Prairie Nature Park within the boundaries of the City of Winnipeg. Tall-grass prairie is still found in Manitoba in a few isolated, relatively undisturbed locations that have not been plowed, but it is not an important rangeland type in Canada.

Introduced grasses have been included along with native species in the generic descriptions. Some of these grasses are seeded beside roadsides or after forest clear-cutting and escape into adjacent land where this is suitable. Others, such as orchard grass, *Dactylis glomerata* L., are planted for hay and usually require irrigation, but may survive in some areas if they escape. Still others, such as Russian wild rye grass, *Elymus junceus* Fischer, and crested wheat grass, *Agropyron cristatum* L. (*sensu lato*), have been deliberately introduced for range improvement in dry areas and are now well established beside native grasses. Commercially grown cereal grasses are included as these often escape from areas of cultivation and may become established. Corn (*Zea mays* L.), which is widely cultivated, and sorghum (*Sorghum bicolor* (L.) Moench), which is being grown experimentally around Lethbridge, Alta., and in southwestern Manitoba, are not included, as they rarely survive beyond cultivation. The genera *Apera*, *Eremopoa*, and *Digitaria* are included because although the records of these being collected are relatively few, they seem to have the potential for becoming more widespread. Several grasses of wetland habitats are included because in unfenced rangeland they are often eaten by cattle feeding around watering holes.

The use of a computer in key generation

Clifford and Watson (1977) discuss the application of computers to the problems of plant identification, claiming that grasses "...probably offer more scope than any other plant group for the immediate implementation of computer techniques." They demonstrate their conviction with impressive computer-generated keys to the grass genera found in different areas of Australia.

We decided to collect data for this study so that it could be used to generate keys by a computer. Such data would provide a thorough basis for describing genera, both on the presence and absence of characters. By using a computer it was hoped that combinations of characters not previously considered in classical treatments would be brought together and prove helpful in grass identification

Grass morphology

Vegetative characters

Root

The true roots of grasses are fibrous without a persisting tap root. Weaver (1954) photographed the complete root system of many of the North American prairie grasses by digging trenches around grass, taking the soil and plants to the laboratory, and carefully removing the soil to expose the elaborate, characteristic root systems. Some of these plants have roots that penetrate 2–3 m below ground level. In the present study, root characters were not used in identification because they were considered of limited use and the work needed to obtain them would not justify the results.

Stem

Rhizomes (underground stems), and stolons (aboveground horizontal stems) (Fig. 2), have nodes and internodes that are not found in roots; roots and/or culms (stems) may be produced from the nodes. The presence or absence of rhizomes or stolons is usually characteristic of a species and often of a genus. Whether or not the horizontal stems are above or below the ground often varies with site conditions; therefore the distinction between stolons and rhizomes is not always easy to make.

Grass culms are usually erect and cylindrical with swollen nodes and elongate internodes. Leaves, branches, and adventitious roots arise at the nodes. All Canadian grasses growing without cultivation have herbaceous culms. In rangelands, many grass species have the "bunchgrass" habit. The culms are crowded together in a dense clump with the leaf sheaths of the previous season's growth, a condition described as tufted, or caespitose. In many bunchgrasses the nodes are toward the base of the culm and completely surrounded by leaf sheaths so that nodes are rarely visible. Most of the length of the culm is a single, elongate internode that bears the inflorescence. This habit contrasts with grasses that have several nodes along the length of the culm with a leaf borne at each node. In most Western Canadian grasses, nodes and internodes are glabrous, but a few species are characteristically pubescent or puberulent.

If a grass is perennial, the base of the culm usually has adhering to it the dried remains of the previous season's growth. These are absent from annual plants, and from the base of perennial plants in their first year of growth. Plant height is variable in grasses, but it is used to distinguish the tall-grass and short-grass prairies and is a factor in identifying their associated species. The heights of grass species recorded here have been based on data in Hitchcock and Chase (1951) and Looman and Best (1979), as well as the examination of herbarium specimens and the authors' field work.

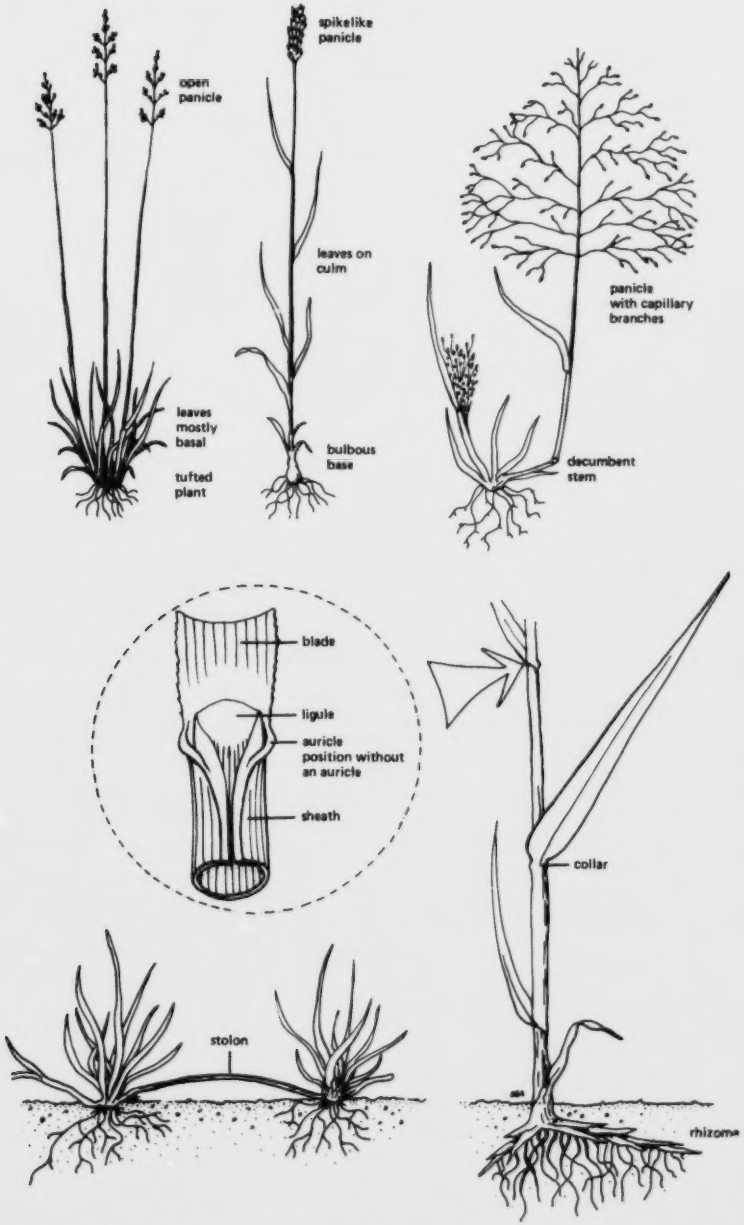

Fig. 2. Plant habit and the vegetative parts of a grass.

Leaf

Grass leaves are borne, more or less, in two rows and alternate at each node of culm. The leaf consists of the blade (lamina) and the sheath that surrounds the stem (Fig. 2). The developing blade within the growing shoot may be rolled (convolute), folded (conduplicate), or either rolled or folded at the midvein with both margins equally rolled inward (involute) (Fig. 3). As the blade matures it may unfold or unroll to a flat lamina surface. However, in dry rangeland conditions, mature leaf blades often remain tightly rolled or folded as they were in development. When these blades are narrow they appear bristly or needlelike and are described as setaceous.

At the junction of the sheath and blade of most grasses a ligule is present on the adaxial surface (Figs. 2, 3, 4). All Western Canadian rangeland grasses have ligules with the exception of members of the genus *Echinochloa*. The function of the ligule is not known. It may vary in length from less than 1 mm to 10 mm and have many forms (Fig. 3). Ligules may be membranous with or without pubescence either at the apex or on the abaxial surface and extending to the apex. Scabrous projections sometimes occur on the abaxial surface. Membranous ligules may remain as a complete structure for the life of the blade and are then described as entire, or they may become frayed at the apical edge shortly after they are formed, and are then described as lacerate. Ligules may also be a fringe of ciliate trichomes and such structures are usually less than 1 mm long.

The abaxial (outer) region of the junction between the blade and the sheath is termed the collar. Figure 4 illustrates the four types of grass collars recognized by Best et al. (1971) who describe collar characters for approximately 100 prairie grasses, recording the collar color, whether the collar is distinct or indistinct, continuous or divided, and glabrous or hairy. For the identification of some grasses, collar characters are useful, but in others the collar characters are highly variable from specimen to specimen, and even from leaf to leaf on the same specimen, so that within some species most of the distinct collar types are found.

At the junction of the ligule and the collar auricles may occur. These are membranous or pubescent outgrowths usually less than 3 mm long. They may be clawlike or rounded extensions at approximately right angles to the sheath and blade; sheath auricles, in which the ligule or sheath margins extend into the auricle positions as erect structures; or tufts of hairs that are longer than the ciliate fringe of the ligule (Fig. 4). Auricle characters are a constant feature in some genera such as *Lolium*, but in others such as *Festuca* their presence or absence varies from species to species. Sometimes auricles are very delicate and do not persist after the blade has expanded. Such delicate auricles are often lost in the preparation of herbarium specimens.

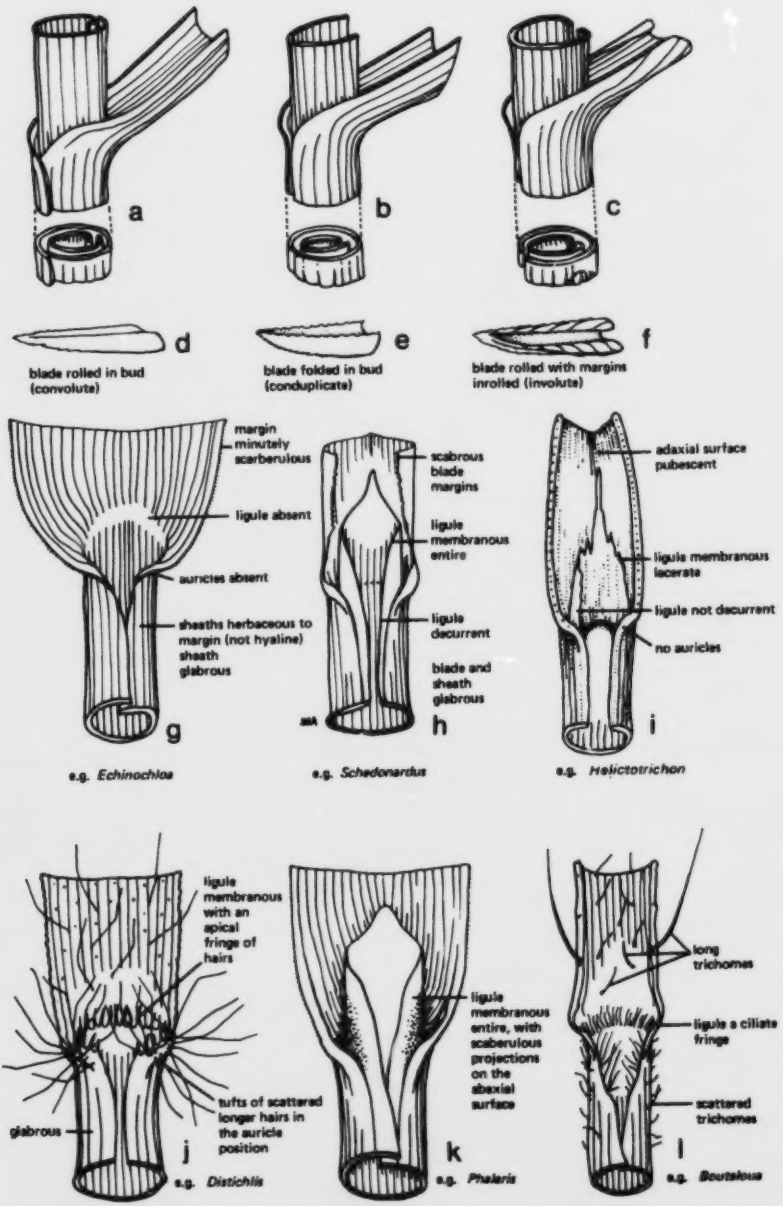

Fig. 3. (*a*–*f*) Shapes of emerging leaves with a cross section view at the junction of the sheath and the blade. (*g*–*l*) Adaxial view of grass leaves at the junction of the sheath and the blade, showing ligule characters.

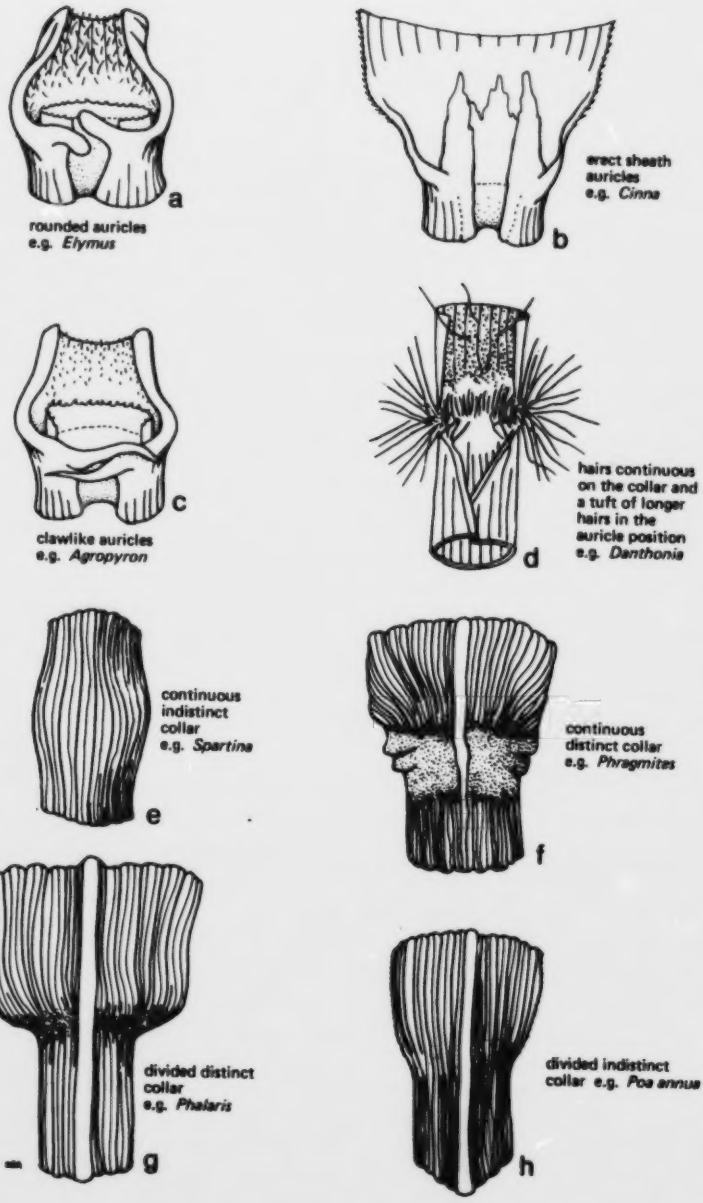

Fig. 4. (*a*–*d*) Adaxial view of grass leaves at the junction of the sheath and the blade, showing characters of auricles and ligules. (*e*–*h*) Abaxial view of grass leaves at the junction of the sheath and blade showing collar characters.

The sheath surrounds the culm for the length or most of the length of an internode. In some grass genera, such as *Bromus* and *Schizachne*, the sheath is closed almost to the top, that is, the margins are joined and do not overlap. Most commonly, the sheath is split to between one-third and two-thirds of its total length, and the margins overlap. More rarely, the leaf sheath is split to the base and relatively loose for its entire length. During development, most grass leaf sheaths are entire cylinders, but in some there is a longitudinal zone of colorless cells in the position where the sheath later splits. Where this zone is very narrow, the mature sheath margins appear similar to the rest of the sheath surface. Where the zone is relatively wide, after the sheath splits the margins have a zone that is membranous or hyaline. To determine whether a sheath is open or closed, mature leaves near the base of the culm should be examined.

The presence of hairs, their length, and the frequency with which they occur on the blade, sheath, or culm surfaces were recorded and found to be variable within certain species, and sometimes even between the basal leaves and the culm leaves of the same plant. There are other species and even genera with leaves that are always glabrous. Most grasses have scabrous projections stiffened by silica along the margins of the leaves and they are also commonly present on the blade surfaces. Scabrous projections usually point in only one direction. Their presence may be felt as roughness by stroking the leaf and they are visible at 10× (with a hand lens). Scaberulous projections may be seen as small, sharp points at 40× (under a microscope), but they are more difficult to feel. A few grasses are smooth without any projections on the margins or the leaf surfaces.

Floral characters

Inflorescence

Grass inflorescences are usually borne terminally on erect culms. They are usually subtended by a leaf that surrounds the inflorescence as it develops (e.g., *Hordeum*, Fig. 27*a*, *Oryzopsis*, Fig. 30*a*). A few inflorescences, mainly in the tribe Andropogoneae, have leafy structures subtending groups of spikelets within the inflorescence (*Schizachyrium*, Fig. 36*a*).

Grass flowers are borne in units termed spikelets with plants producing numerous spikelets. The way in which they are borne in the inflorescence gives a great deal of useful taxonomic information. For example, spikelets may be sessile on the main axis (rachis), in which case the inflorescence is a spike (e.g., *Agropyron*, Fig. 25*a*), or stalked on branches from the main axis in a panicle (e.g., *Panicum*, Fig. 33*a*). Panicles may be once branched (e.g., *Echinochloa*, Fig. 32*a*), or much branched (e.g., *Oryzopsis*, Fig. 30*a*, *Bromus*, Fig. 6*a*). The primary branches vary in length considerably. They may be so short that the inflorescence looks spicate rather than paniculate; for example, the

contracted panicle conditions illustrated for *Koeleria* (Fig. 20*a*) and *Polypogon* (Fig. 23*a*). It is useful to distinguish a spicate inflorescence in which the culm terminates in a single, simple spike, or ear (e.g., *Elymus*, Fig. 26*a*, *Agropyron*, Fig. 25*a*, *Hordeum*, Fig. 27*a*) from those with two or more spikes that may be further subdivided according to whether they are digitately arranged (for example, the inflorescence of crab grass, *Digitaria* spp.) or not digitately arranged (e.g., *Schedonnardus*, Fig. 41*a*).

The type of inflorescence produced by a species is a consistent taxonomic character (i.e., a species will produce either a panicle or a spike but not both). One exception occurs in *Danthonia unispicata*, a species that often has only a single spikelet in the inflorescence, in which case it may be interpreted as spicoid. However, when plants of this species produce 2–3 spikelets, they are arranged in a loose panicle. Among Western Canadian rangeland grasses the length of the branches in a panicle may vary considerably, as in *Koeleria* (Fig. 20*a*,*b*), and *Beckmannia* that may have a relatively open panicle, or a compact spikelike inflorescence.

The inflorescence rachis and the rachis branches are usually rounded. In some taxa they are flattened with either two angles (*Agropyron*) or three angles (*Spartina*, *Bouteloua*). A flattened rachis may contribute to the secund condition in which spikelets appear to arise only from one side of the inflorescence rachis, or to a bilaterally symmetrical inflorescence where spikelets are borne alternately at approximately 180° from each other (for example, the spikes of crested wheat, *Agropyron cristatum* L.). In extreme examples, such as *Lolium*, the flattened rachis is concave, or hollowed, adjacent to the spikelet. As with vegetative organs, it has been useful to record the vestiture of the inflorescence and spikelets as (1) glabrous if there are no trichomes; (2) scabrous if there are short, stiff trichomes (probably containing silica, which makes the surface feel rough); and (3) pubescent if the trichomes are flexible (lacking silica so that they are not stiff but feel or appear soft). These conditions are illustrated in the following examples: glabrous, *Lolium* (Fig. 8*b*), scabrous *Agrostis* (Fig. 13*c*), and pubescent *Schizachyrium* (Fig. 36*c*). In a few grasses there is an involucre at the base of the spikelets composed of one or more structures. In *Setaria* (Fig. 34*c*,*h*), the involucres are made up of relatively long bristles. In some grasses of the tribe Triticeae the involucre is no more than a remnant flap of tissue.

Spikelet

The spikelet is the basic unit of a grass inflorescence. It is interpreted as being a modified flower-bearing branch, of which the central axis, the rachilla, bears one to several florets that are usually subtended by two bracts, the glumes. Some spikelets have many florets; for example, those in species of *Bromus* (Fig. 6*c*) and *Distichlis* (Fig. 43*d*,*e*), others normally have only 2–3 florets per spikelet; for example, species

of *Koeleria* (Fig. 20*c*) and *Sphenopholis* (Fig. 24*c*), and many have only a single floret; for example, those in species of *Agrostis* (Fig. 13*c*) and *Schedonnardus* (Fig. 41*d*). Above the glumes and subtending each of the florets is a bract, or lemma. Each lemma usually surrounds a short shoot bearing a bracteole, or palea, and a flower. The spikelets of festucoid grasses such as *Bromus* may be interpreted as a condensed racemose inflorescence. In these, the flowers mature from the base of the spikelet first. As the axis is indeterminate the rachilla continues beyond the uppermost fertile floret as a stiff trichome or a short stalk commonly bearing one or more vestigial florets. By contrast there are many spikelets that are interpreted as highly condensed cymes. These have no terminal continuation of the rachilla, and growth is determinate. The spikelet has a single terminal, completely hermaphrodite flower and usually a lower structure that varies from a completely hermaphrodite floret to no more than a single sterile lemma. Sometimes there may be more than one sterile lemma present, for example *Phalaris* (Fig. 21*e,g*). Recognizing a theoretical difference in the type of inflorescence structure that may explain a spikelet is useful in the extreme examples. However, there are several grasses with spikelets that have single hermaphrodite florets and no sterile structures. They are assumed to represent end points of reduction series from either inflorescence type, and the affinities of different genera of such grasses have been the subject of much discussion.

A useful character in identification is the plane of spikelet compression. This is best determined in flowering material because the swelling of the fruit may alter the general shape. At anthesis, most grass spikelets are strongly compressed so that if one is placed on a flat surface it lies either on its side, the laterally compressed condition (*Avena*, Fig. 15*b,d*, *Phalaris*, Fig. 21*d,f*), or on its front or back, the dorsally compressed condition (*Echinochloa*, Fig. 32*f,g*, *Panicum*, Fig. 33*d,e*). Panicoid spikelets are usually dorsally compressed; most other grasses are laterally compressed. A few grasses such as *Stipa* or *Oryzopsis* are not compressed, and the flowers are terete.

Cleistogamy (pollination and fertilization within closed florets) complicates grass identification. Cleistogamous spikelets usually differ from those of the same species that do open for pollination and fertilization (chasmogamous spikelets). The former may have greatly reduced lemmas and paleas, and relatively short stamens and styles. Some grasses produce cleistogamous spikelets in lieu of their usually chasmogamous ones, seemingly in response to extreme or stressful environmental conditions (Clifford and Watson 1977), and some grasses are completely cleistogamous. The extent of cleistogamy among Western Canadian rangeland grasses is unknown and few of the associated morphological states have been described. Our descriptions refer almost entirely to chasmogamous florets. Vivipary is the condition where small plants are found replacing some or most of the florets. It may result from the sprouting of seeds still attached to the spikelet,

producing plantlets with a coleoptile. Vivipary may be genetically based or ephemeral, resulting from stressful environmental conditions that induce vegetative proliferation in which the spikelet axis continues growing and produces plantlets that have no coleoptile. Usually at the base of such spikelets the glumes and lemmas are found varying from their normal structure to foliage leaves (Wycherley 1953).

Glumes

Many characters associated with the glumes are useful for identification. The number of glumes varies from two in most spikelets to one in *Lolium* spikelets (except the terminal) and zero (glumes absent) in *Leersia* and *Zizania*. The size of glumes relative to the rest of the spikelet, and the size of one glume proportional to the other, are often characteristic. In most species it is unambiguous whether glumes are more or less equal, very unequal (the lower glume less than half the size of the upper glume), or absent. General glume shape is also useful, for example: the glumes of *Alopecurus* (Fig. 14*c,f,h*) are laterally compressed, acute, and keeled with long cilia on the keels; the glumes of *Beckmannia* (Fig. 16*e*) and *Phalaris* (Fig. 21*f*) are laterally compressed, broad, and so expanded at the margins or keel that they are described as winged. In dorsally compressed spikelets such as those of *Panicum* the glumes are rounded on the back and may completely surround the base of the spikelet (Fig. 33*d,e*). The term keel is used to describe a vein at which there is sharp folding so that an angle of less than 45° is made by the fold. Setaceous, literally bristlelike, is a term used to describe narrow glumes that are many times longer than wide. Some glumes that are only apically setaceous are expanded at the base, where they may include 2–3 veins very close together. However, only where the general impression is of a long, narrow, bristlelike structure are the glumes described as setaceous.

Callus

Callus is a relatively imprecise term referring to the hard, often pointed base of a floret just above the point of disarticulation. It is usually closely associated with the base of the lemma and when covered with hairs is conspicuous and termed bearded (*Calamagrostis*, Fig. 17*d*). Occasionally callus hairs merge with lemma pubescence (*Stipa*, Fig. 31*e*). In some *Poa* species the lower half of the lemma is more conspicuously pubescent than the upper half, but there is no distinguishable callus tissue associated with this pubescence. In other *Poa* species there is a structure, traditionally called the web, that is a mass of long, silky, cobwebby hairs at the base of the lemma, loosely associated with the callus position.

Lemma

The shape of the lemma apex, the number of veins in the lemma, and lemma vestiture are useful taxonomically. A distinction can be made between lemmas in which the veins converge near the apex (*Avena*, Fig. 15*c*,*e*) and those lemmas in which the veins do not converge but remain parallel or diverge (*Lolium*, Fig. 8*c*,*e*,*g*). In some genera the veins do not reach to the apex (*Poa*, Fig. 9*g*,*h*, *Puccinellia*, Fig. 10*e*–*h*).

Lemmas are either keeled or rounded on the back and this is usually consistent within a genus. Lemma vestiture can often be used to distinguish species in a genus or varieties within a species. Lemma texture may be a useful identification characteristic, for example some lemmas are delicately membranous and enclosed within much firmer glumes (*Schizachyrium*, Fig. 36*g*,*i*), others harden as they mature, becoming indurate or coriaceous (*Stipa* and *Avena*). In most Western Canadian rangeland grasses, the texture of glumes and lemmas is similar.

Awns

Awns are slender, bristlelike projections found on glumes, lemmas, and very rarely on paleas (e.g., glume awns, *Polypogon*, Fig. 23*c*; lemma awns, *Vulpia*, Fig. 12*e*). Lemma awns seem generally to be concerned with dispersal of the grain by animals or with gaining entry into the soil (Clifford and Watson 1977). The biological significance of awn morphology and the function of awns in seed dispersal has been investigated by Peart (1979). In some genera the lemmas are characteristically awned, for example *Stipa*, whereas others are entirely awnless, for example *Glyceria*. Some genera, such as *Bromus* and *Festuca*, have both conditions among their species. Occasionally, within a species some specimens have lemmas that are awnless, others mucronate, and still others distinctly awned, for example in *Agropyron spicatum*. It may be difficult to distinguish a short awn from a long mucronate or acuminate apex. For the purposes of this publication, awns are defined as having a mean length of at least 1 mm on the basis of samples measured from five collections.

The position from which awns arise is taxonomically useful. Awns on glumes always arise from an unnotched apex, as do the lemma awns in some genera such as *Muhlenbergia* and *Festuca*. In those species of *Bromus* with awned lemmas there is an apical notch from the base of which the awn arises. *Stipa* and *Oryzopsis* have lemmas that are cylindrical and taper to a conelike apex from which an apical awn arises. In some genera, for example *Alopecurus* and *Avena*, the awn arises from the lower back of the lemma between the middle and the base. These distinctions are constant enough to be of diagnostic value. Awn length is more variable but the concept of a long awn (more than 2 cm) and a short awn (less than 1 cm) is useful in field identifications.

Glume awns, and some lemma awns such as those of *Festuca* and *Triticum*, are straight at anthesis. These may remain straight or curve as the fruit matures and the lemma dries out (*Agropyron*, Fig. 25*b*). Other awns, such as those of *Stipa* species, are more complex in structure and respond dramatically to changes in humidity. The base of a *Stipa* awn when dry is spirally twisted, whereas the distal end remains straight. At the junction there is usually an elbowlike bend and when this is present the awn is described as geniculate. Such awns respond to changes in humidity by twisting and untwisting with sufficient force so that the pointed callus at the opposite end may penetrate the tough hides of cattle, or help to bury seeds in the ground.

Palea

The palea is a bracteole that when present occurs opposite the lemma and adjacent to the rachilla. The margins of the lemma usually overlap the palea. The length of the palea varies from as long as the lemma (e.g., *Scolochloa*, Fig. 11*e*), to much shorter (e.g., *Stipa*, Fig. 31*e,f*) or absent (e.g., *Alopecurus*). The paleas of most Western Canadian rangeland grasses have two veins and are folded at both veins so that the margins enclose the floral structures. A palea that appears laterally compressed may have two veins which are so close together at the center that they appear as one, or the two veins may be distinct but each is so sharply keeled that the palea surface between the veins folds inward like an inverted pleat (*Secale*, Fig. 28*c*). Paleas in the tribe Stipeae are not keeled and are gently rounded to flat. Paleas are commonly delicate and membranous with green or yellow pigmentation only along the veins. Some paleas, such as those found in *Panicum*, may mature into hard, indurate structures that are completely opaque and heavily pigmented. There is considerable variation in palea vestiture; for example, there are long hairs in the center of the palea of *Oryzopsis hymenoides*, long ciliate trichomes on the palea keels of *Bromus tectorum*, and scabrous margins in *Schizachyrium scoparium*. Among Western Canadian rangeland grasses most of the paleas have trichomes at least on the veins.

Flower

The structures in grasses believed to be homologous with the perianth of the flowers of other plants are termed lodicules. When present they are almost always much shorter than the palea, and transparent or whitish. In some grasses, for example *Alopecurus*, they are absent. Most Western Canadian rangeland grasses have two free lodicules, but in *Glyceria* the lodicules are often fused. In the tribe Stipeae, flowers commonly have 2–3 lodicules, with the third lodicule at various stages of reduction in different flowers on the same plant. Just before anthesis the lodicules swell, separating the lemma and the palea so that anthers and stigmas are easily exerted. Lodicules take different forms that are taxonomically useful when the structures are examined

under a microscope at 40−160×. Some of these forms are illustrated in Fig. 5. The importance of lodicules in the taxonomy of grasses is discussed in a thorough investigation by Jirasek and Jozifova (1968).

The stamens arise between the lodicules and the ovary. Grass flowers usually have three stamens. Flowers of *Zizania* have six stamens, those of *Glyceria* sometimes only two, whereas in *Cinna* and *Vulpia* there is usually only one. Anther color may be either yellow or reddish and was examined as a potential taxonomic aid, but found to be variable within genera and species.

The ovary is in the center of the flower. In most grass genera the ovary is glabrous (e.g., *Sporobolus*, Fig. 39*e*), but in some the ovary apex is pubescent (e.g., *Agropyron*, Fig. 25*f*, *Helictotrichon*, Fig. 19*e*). In most Western Canadian rangeland grasses the styles are free to the base (e.g., *Bromus*, Fig. 6*f*), but in *Alopecurus* (Fig. 14*e*) the styles are joined for a

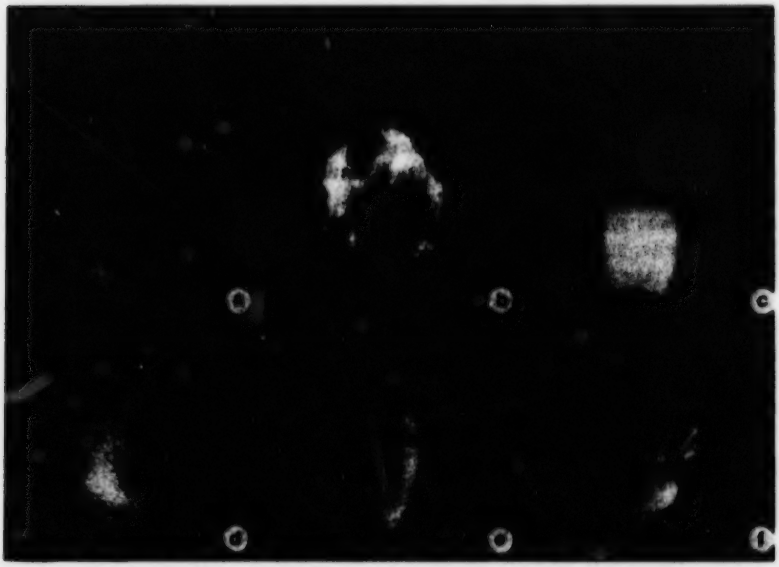

Fig. 5. Lodicule characters. (*a*) Lodicule membranous, entire; base fleshy; apex 1−2 cells thick, rounded. *Bromus kalmii* approximately 60×. (*b*) Lodicule membranous, toothed; similar to (*a*) but membranous upper portion divided into 2 teeth. *Poa compressa* approximately 80×. (*c*) Lodicule pubescent, membranous, toothed; similar to (*b*) but with marginal trichomes. *Agropyron dasystachyum* approximately 60×. (*d*) Lodicule fleshy, entire; apex several cells thick, rounded. *Setaria glauca* approximately 60×. (*e*) Lodicule fleshy, with a single lobe at the outer, apical margin. *Bouteloua gracilis* approximately 90×. (*f*) Lodicule fleshy, with undulating apex. *Panicum virgatum* approximately 50×.

short distance above the ovary apex. In most Western Canadian rangeland grasses the stigmas are colorless or white, but some, especially members of the tribe Paniceae, are characteristically brownish red or purple.

Grasses vary characteristically in the structures that are shed with the mature fruit and seed. In *Calamovilfa* and *Sporobolus* the seed has a well-developed seed coat and at maturity is isolated from the ovary wall that splits to release it. In all other Western Canadian rangeland grasses the seed is fused to the ovary wall, and the whole structure is shed as a fruit (caryopsis). The lemma and palea are usually closely associated with the fruit. It is taxonomically useful to distinguish those spikelets that disarticulate below the glumes, causing the glumes to shed with the fruit (e.g., *Echinochloa*, Fig. 32*b*,*c*), from those that disarticulate above the glumes, with these bracts being left on the rachis (e.g., *Lolium*, Fig. 8*b*). In andropogonoid grasses such as *Schizachyrium* the rachis disarticulates immediately below the node where the spikelets are borne and they fall in pairs together with the upper rachis internode. The wild members of the genus *Hordeum* release fruit by disarticulation of the central rachis, just above the node where the spikelets are borne, and they are released with the lower rachis internode. However, in barley (*Hordeum vulgare*) and in many other cereal grasses, selective breeding has resulted in the mature florets remaining attached until they are released by threshing. In a few species, the inflorescence disarticulates from the culm as a unit (e.g., *Schedonnardus*).

Methods

The techniques recommended by Clifford and Watson (1977) formed the basis of this work. Preliminary study established that some of the characters of their attribute list apply only or mainly to tropical grasses. For this study a new attribute list was developed that is more appropriate to Canadian genera (Table 1). In particular, the vegetative characters given by Best et al. (1971) were incorporated. Many of the characters used by Baum (1977) were also adopted, but others were considered to be too specific to the tribe Triticeae.

Specimens in Agriculture Canada's herbarium at Ottawa (DAO) were used in this study. For a few rare or poorly collected species, specimens in the National Museum herbarium (CAN) were also examined. Information was obtained from grass collections and from scientists at the Agriculture Canada Research Stations at Brandon, Kamloops, Lethbridge, and Swift Current, and at the University of Saskatchewan. Specimens were collected during field work in 1980. The genera considered to be in Western Canadian cattle rangelands are listed in Table 2. The species represented in the Western Canadian rangelands and commonly used synonyms are given in the list following each generic description. References to relevant research is also presented for many of the genera.

Table 1. The attribute list

1. Plants
   A. Without long rhizomes, stolons, or decumbent stems.
   B. With long rhizomes below the surface of the ground.
   C. With long stolons above ground, or with decumbent stems occasionally rooting at the nodes.
2. Plants
   A. Annual or biennial.
   B. Perennial.
3. Plants
   A. Less than 50 cm high.
   B. More than 50 cm high.
4. Plants
   A. Less than 25 cm high.
   B. 25–50 cm high.
5. Plants
   A. 50–150 cm high.
   B. More than 150 cm high.
6. Leaves
   A. Mostly basal (fewer than one-quarter of the total number of leaves on the culms).
   B. Mostly on the culms, or both basal and on the culms but not mainly basal.
7. Upper culm internode
   A. With a continuous, spongy or solid pith.
   B. Hollow, without a continuous central pith.
8. Upper culm internodes
   A. Glabrous.
   B. Scabrous, puberulent, or pubescent.
9. Culm nodes
   A. At least some exposed.
   B. Almost never exposed.
10. Upper culm nodes
   A. Glabrous.
   B. Puberulent or pubescent.
11. Blade
   A. Rolled in bud.
   B. Folded in bud.
   C. Folded or rolled at the midvein, both margins evenly inrolled, involute.
12. Blade
   A. Setaceous either by rolling or folding of the blade.
   B. Not setaceous.
13. Blade
   A. Less than 0.5 cm wide.
   B. 0.5–1.2 cm wide.
   C. More than 1.2 cm wide.
14. Adaxial surface of the blade (upper culm leaf)
   A. Glabrous.
   B. Scabrous.
   C. Puberulent or pubescent.

15. Abaxial surface of the blade (upper culm leaf)
    A. Glabrous.
    B. Scabrous.
    C. Puberulent or pubescent.
16. Blade edge
    A. Smooth, without scaberulous or scabrous projections.
    B. With minute, not easily felt, scaberulous projections visible at 40×.
    C. With easily felt scabrous projections visible at 10×.
17. Midvein
    A. Prominent, at least 2 times the width of any other leaf vein for at least half the blade length.
    B. Less than 2 times the width of any other leaf vein (measured at the base of the blade and checked from the adaxial side).
18. Leaf sheath
    A. Split less than one-third of the internode length.
    B. Split more than one-third of the internode length.
19. Upper leaf sheath margins
    A. Membranous or hyaline.
    B. Not membranous or hyaline.
20. Leaf sheath margins
    A. Only the exposed margin pubescent or ciliate.
    B. Both sheath margins similar.
21. Leaf sheath margins
    A. Glabrous.
    B. Scabrous, pubescent, or ciliate.
22. Leaf sheath vestiture away from margin
    A. Glabrous.
    B. Scabrous, puberulent, or pubescent.
23. Leaves
    A. With ligules.
    B. Without ligules.
24. Ligule
    A. Membranous, without hairs.
    B. Membranous, with hairs.
    C. A fringe of hairs, without membranous tissue.
25. Ligule apex
    A. Entire.
    B. Lacerate, dentate.
26. Upper culm leaf ligule
    A. Less than 2 mm.
    B. 2 mm or more.
27. Upper culm leaf ligule
    A. Less than 1 mm.
    B. 1–less than 2 mm.
28. Upper culm leaf ligule
    A. 2–3 mm.
    B. More than 3–less than 5 mm.
    C. 5 mm or more.
29. Auricles
    A. Present.
    B. Absent.

30. Auricles
    A. Clawlike or rounded, clasping the stem.
    B. Erect, an extension of the leaf margin (sheath auricles).
    C. Position with a tuft of hairs.
31. Collar
    A. Distinct.
    B. Indistinct.
32. Collar
    A. Divided by the midvein.
    B. Undivided by the midvein.
33. Inflorescence
    A. With leaves other than a basal flag leaf.
    B. Without leaves or only a basal flag leaf.
34. Inflorescence
    A. Spicate.
    B. Paniculate.
35. Spicoid inflorescence
    A. A single, simple spike.
    B. Of 2–several simple spikes digitately or subdigitately arranged.
    C. Of 2–several simple spikes not digitately or subdigitately arranged.
36. Paniculate inflorescence
    A. Contracted and spikelike.
    B. More or less open and diffuse.
37. Spicate inflorescence spikelets
    A. Secund.
    B. Not secund.
38. Rachis
    A. Markedly flattened, concave, winged, or ridged.
    B. Not flattened, concave, winged, or ridged.
39. Rachis
    A. Glabrous.
    B. Scabrous, pubescent, or puberulent.
40. Spikelet
    A. Readily disarticulating above the glumes when mature.
    B. Disarticulating below the glumes when mature.
    C. Not readily disarticulating when mature.
41. Spikelet involucres
    A. Absent.
    B. Present.
42. Spikelet involucres
    A. A ring of hairs or a remnant ring of tissue less than 2 mm high.
    B. Around spikelets or spikelet clusters, 2 mm or more high.
43. Spikelets
    A. Compressed laterally.
    B. Compressed dorsally.
    C. Not noticeably compressed.
44. Spicate inflorescence
    A. Spikelets usually solitary at each rachis node.
    B. More than 1 spikelet at each rachis node.
45. Spicate inflorescence
    A. Spikelets in pairs at each rachis node.
    B. Spikelets in triplets at each rachis node.

46. Spikelets
    A. In pairs or triplets with at least 1 sessile and 1 pedicellate spikelet or spikelet remnant (andropogonoid arrangement).
    B. Not an andropogonoid arrangement.
47. Spikelets
    A. With at least 1 hermaphrodite flower.
    B. With no hermaphrodite flowers.
48. Hermaphrodite flowers
    A. 1 per fertile spikelet.
    B. More than 1 per fertile spikelet.
49. Reduced florets
    A. Below the hermaphrodite flowers.
    B. Above the hermaphrodite flowers.
50. Rachilla
    A. Prolonged beyond the uppermost fertile floret.
    B. Not prolonged beyond the uppermost fertile floret.
51. Rachilla
    A. Glabrous.
    B. Scabrous, puberulent, or pubescent.
52. Glumes
    A. Absent.
    B. 1.
    C. 2.
53. Longest glume in the spikelet
    A. Less than 1 mm long.
    B. More than 1 mm long and decidedly shorter than the lemma of the proximal floret.
    C. More than 1 mm long and exceeding or approximately equaling the lemma of the proximal floret.
54. Glumes
    A. Very unequal.
    B. Equal or subequal.
55. Glumes
    A. Laterally compressed or keeled, usually less than 3 times as long as wide.
    B. Rounded (not setaceous).
    C. Very narrow, sometimes setaceous, at least 3 times longer than wide.
56. Glumes
    A. Winged or inflated.
    B. Not winged or inflated.
57. Lower glume
    A. No nerves.
    B. 1–3 nerves.
    C. 4 or more nerves.
58. Lower glume
    A. 5 or 5–7 nerves.
    B. More than 7 nerves.
59. Upper glume
    A. No nerves.
    B. 1–3 nerves.
    C. 4 or more nerves.
60. Upper glume
    A. 5 or 5–7 nerves.
    B. More than 7 nerves.

61. Hairy callus
    A. Present.
    B. Absent.
62. Lemma apex
    A. Obtuse or rounded, lemma not awned.
    B. Acute or lemma awned.
63. Lemma veins
    A. Converging toward the apex.
    B. Not converging toward the apex, the lateral veins not running the full length of the lemma.
64. Lemma
    A. No nerves.
    B. 1–3 nerves.
    C. More than 4 nerves.
65. Lemma
    A. 5 or 5–7 nerves.
    B. 7 or 7–9 nerves.
    C. More than 9 nerves.
66. Lemma
    A. With a single keel.
    B. Rounded, flat, or with 2 or more keels.
67. Lemma
    A. Glabrous.
    B. Scabrous, puberulent, or pubescent.
68. Lemma
    A. Membranous, less substantial than the glumes.
    B. Membranous, firmer than the glumes, or of similar firmness.
    C. Hardened when dry and mature, indurate.
69. Lemma
    A. Awned, at least sometimes.
    B. Awnless.
70. Lemma
    A. With a simple awn.
    B. With 1 bifid or trifid awn.
    C. With 3 awns.
71. Lemma awned
    A. Dorsally, with an apical notch.
    B. Dorsally, with no apical notch.
    C. Apically.
72. Dorsal awn
    A. Arising from the upper one-quarter or very near the apical notch.
    B. Arising from near the middle or below.
73. Awn
    A. Less than 2 cm long.
    B. More than 2 cm long.
74. Awn
    A. Straight or curved.
    B. Spirally twisted and/or geniculate.
75. Palea
    A. Absent, or less than one-quarter of the lemma length.
    B. Present, and one-quarter or more of the lemma length.
76. Palea nerves
    A. Absent or 1.
    B. 2 or more.

77. Palea
    A. Rounded or flat throughout.
    B. Rounded between 2 nerves, and keeled at the nerves.
    C. Laterally compressed.
78. Laterally compressed palea
    A. Folded at a single nerve or 2 nerves close together.
    B. Pleated inward between 2 nerves.
79. Palea
    A. Transparent or translucent.
    B. Colored, at least on the nerve(s).
80. Palea
    A. Glabrous.
    B. Scabrous, puberulent, or pubescent.
81. Stamens
    A. 1.
    B. 2.
    C. 3.
    D. 6.
82. Anthers
    A. Yellow.
    B. Red, purple, or black.
83. Ovary apex
    A. Glabrous.
    B. Pubescent.
84. Styles
    A. Fused at least near the base.
    B. Free to the base.
85. Stigma
    A. Translucent or white.
    B. Yellowish or golden.
    C. Red, pink, purple, or black.
86. Lodicules
    A. Present.
    B. Absent.
87. Lodicules
    A. Seemingly 1, or the pair fused.
    B. 2 or 3, not fused.
88. Lodicules
    A. 2.
    B. 3.
89. Lodicules
    A. Fleshy.
    B. Membranous (at least at the apex).
90. Lodicules
    A. Glabrous.
    B. Pubescent.
91. Membranous lodicule margin
    A. Toothed.
    B. Not toothed.
92. Apex of fleshy lodicule
    A. Rounded.
    B. Lobed or undulating.

In compiling data, at least five specimens of each species were examined in detail. Specimens were chosen from each province in Western Canada in which the species grow, to ensure that account was taken of any geographical diversity. Special attention was given to the scoring for the presence or absence of trichomes on sheaths, blades, culms, glumes, and lemmas, the number of nerves in the glumes and lemmas, and the size of the palea relative to the lemma. A summary of the data for each species was compiled (see Appendix to Table 1). For genera with more than one species a generic summary of the data collected was made. Where characters were found to vary either within a species or within a genus this was recorded as V for variable. Otherwise characters were scored as A, B, or C as given in Table 1.

With the cooperation of the Engineering and Statistical Research Institute, Agriculture Canada, these data, including the characters in the attribute list, were fed into the computer program KEY developed by Dallwitz (1974). This program was chosen over alternatives such as the Pankhurst KEYGEN (Pankhurst 1971, 1978) because the basic strategy used in the KEY program aims to minimize the probability of error in using the key. The main considerations given in assessing the merit of a character are the reliability of the character (as estimated by the user), the evenness of the division produced by the character, and the amount of extra-taxon variability for the character. The user has a high degree of control over strategy, as the relative importance of these criteria may be specified, and the automatic choice of characters may be overridden. User control involves applying weightings from one to nine to the characters. Where no weighting is stipulated, a value of five is automatically applied. A weighting value of more than five influences the computer program to select that character early. A weighting of less than five reduces the chances of the character being selected. A weighting of zero eliminates the use of a character. Initially, in the interests of brevity, a control was placed on the program to limit to four the number of confirmatory characters presented in a key. When a satisfactory key was produced the limit was changed to 25 confirmatory characters, so that all potentially useful information could be considered.

In using the KEY program for data collected on Western Canadian rangeland grasses, many different weightings were tried. The program was run without any weighting, with vegetative characters weighted above five, usually to seven, to produce a key that would use these characters as early leads, and conversely, weighted to produce a key that stressed floral characters. However, the computer is not a botanist, and it was found desirable to synthesize a single key, based on leads suggested in the computer-generated keys, and to incorporate in that key botanic experience and judgment as to the usefulness and appropriateness of leads suggested by the computer program. Sometimes this involved supplementing the computer-generated key with distinctive characters

that were not considered on the attribute list because they apply only to a limited number of genera. Botanic judgment was used to incorporate the hybrid genera, ×*Agroelymus*, ×*Agrohordeum*, and ×*Elyhordeum*, into the key, as they created problems in running the computer program due to their variability and because they possess characters that overlap with the parental genera.

Results

Genera considered to occur in Western Canadian cattle rangelands are listed in Table 2; they are arranged in tribes, following Gould (1968). The data obtained and used in the preparation of computer keys are listed in Appendix to Table 1. This list includes coded, generic information for 64 genera and is more complete than the written descriptions, because scoring for all the characters examined is given. In written descriptions negative information is not always recorded, but it can be of importance, especially in tribes where the absence is characteristic of the tribe. The generic descriptions following the key are arranged alphabetically within the tribes adopted by Gould (1968) and are in the order given in Table 2.

Table 2. Grass genera considered to be in Western Canadian cattle rangelands, placed in the tribes suggested by Gould (1968), and arranged alphabetically within each tribe

Tribe Poeae:* *Bromus, Dactylis, Eremopoa, Festuca, Lolium, Poa, Puccinellia, Scolochloa, Torreyochloa, Vulpia*

Tribe Aveneae: *Agrostis, Alopecurus, Apera, Avena, Beckmannia, Calamagrostis, Cinna, Deschampsia, Helictotrichon, Hierochloë, Koeleria, Phalaris, Phleum, Polypogon, Sphenopholis, Trisetum*

Tribe Triticeae: ×*Agroelymus*, ×*Agrohordeum, Agropyron*, ×*Elyhordeum, Elymus, Eremopyrum, Hordeum, Secale, Sitanion, Triticum*

Tribe Meliceae: *Catabrosa, Glyceria, Schizachne*

Tribe Stipeae: *Oryzopsis, Stipa*

Tribe Paniceae: *Dichanthelium, Digitaria, Echinochloa, Panicum, Setaria*

Tribe Andropogoneae: *Andropogon, Schizachyrium, Sorghastrum*

Tribe Eragrosteae: *Calamovilfa, Eragrostis, Muhlenbergia, Munroa, Sporobolus*

Tribe Chlorideae: *Bouteloua, Buchloë, Schedonnardus, Spartina*

Tribe Aeluropodeae: *Distichlis*

Tribe Aristideae: *Aristida*

Tribe Oryzeae: *Leersia, Zizania*

Tribe Arundineae: *Phragmites*

Tribe Danthonieae: *Danthonia*

*Voss (1972). "If *Festuca* is included in the same tribe and subfamily as *Poa*, the names of the higher ranks must be based on the stem of the type genus *Poa*."

Key to grass genera of Western Canadian cattle rangelands

1. Mature leaf sheath open less than one-third of the internode length; margins fused to near the top (Fig. 6*b*) 2
1. Mature leaf sheath open more than one-third of the internode length; margins separated or overlapping (Fig. 3*g*–*l*) 5
   2. Lemma apex rounded (Fig. 10*e*), or truncate (Figs. 10*g*,18*d*), erose, awnless 3
   2. Lemma apex pointed or bifid (Fig. 6*d*), awned or mucronate (sometimes lacking in *Bromus inermis*) 4
3. Spikelets with 1(–2) floret(s); glumes nerveless or the upper faintly 1–3-nerved, the apex toothed or erose; lemma strongly 3-nerved, the apex truncate, erose, not rounded; lodicules 2, free, membranous ..... 37. ***Catabrosa aquatica***
3. Spikelets with 3 or more florets; glumes 1-nerved, the apex acute, entire obtuse or rounded; lemma 5–7(9)-nerved, the apex rounded, obtuse or acute, rarely erose; lodicules 2, fused at least near the base, fleshy ..... 38. ***Glyceria***
   4. Ligule often joined in front to form a continuous collar around the culm; lemma callus strongly bearded (Fig. 29*e*), awn twisted and geniculate; ovary apex glabrous; lodicules 2, fused at the base, fleshy; perennials of woods and parklands .. 39. ***Schizachne purpurascens***
   4. Ligule not joined in front to form a continuous collar around the culm; lemma callus not bearded (Fig. 6*d*), awn usually straight, rarely twisted and flexuous (*B. japonicus*); ovary (and caryopsis apices) pubescent (Fig. 6*f*); lodicules 2, free, membranous; annuals or perennials of various habitats ..... 1. ***Bromus***
5. Spikelets unisexual, the staminate and pistillate conspicuously different (even when borne on the same inflorescence) 6
5. Spikelets with at least 1 bisexual floret (abortive or vestigial stamens present in sterile hybrids and apomicts). Spikelets staminate and pistillate, not conspicuously different 8
   6. Culms 1–3 m; ligule membranous, without ciliate fringe, 3–11 mm long (Fig. 45*c*); inflorescence a large, open panicle (Fig. 45*a*) with staminate and pistillate spikelets; plants annual, emergent in aquatic habitats ..... 62. ***Zizania palustris***
   6. Culms less than 0.5 m; ligule a fringe of hairs or a ciliate membrane to 2 mm long (Fig. 3*j*,*l*); inflorescence a spike or compact, spikelike panicle, with staminate or pistillate spikelets; plants perennial in terrestrial habitats 7
7. Thin, wiry stolons present, rhizomes usually absent; blades lax, curly, not 2-ranked; sheaths slightly inflated, margins not overlapping; ligule a fringe of hairs; female spikelets globose in burlike clusters; male spikelets in 2 rows on one side of the rachis or rachis branch (compare Fig. 40*b*) ..... 56. ***Buchloë dactyloides***
7. Stolons absent, heavy, scaly rhizomes present; blades stiff, erect, 2-ranked (Fig. 43*a*,*b*); sheaths not inflated, margins overlapping to near top; ligule membranous with a ciliate apex (Fig. 43*c*); female spikelets laterally compressed, not in burlike clusters; male spikelets in 2 rows, one on either side of the rachis ..... 59. ***Distichlis spicata***

8. Spikelets with 1 hermaphrodite floret (depauperate specimens of some Aveneae that would normally have 2 perfect florets per spikelet may key here); staminate or sterile florets, if present, below the hermaphrodite floret 9
8. Spikelets with more than 1 hermaphrodite floret per spikelet (abortive or vestigial stamens present in sterile hybrids and apomicts); staminate or sterile florets, if present, above the hermaphrodite florets 37
9. Lemma laterally compressed and distinctly keeled 10
9. Lemma terete or dorsally compressed, (occasionally slightly keeled apically) 14
10. Lemma 1–3 nerves 11
10. Lemma 5 or more nerves 13
11. Rachis angled or winged; spikelets secund on panicle branches (Fig. 42*b*); glumes unequal, the keel pectinate or ciliate (Fig. 42*f,g*) .. 58. ***Spartina***
11. Rachis not angled or winged; spikelets not secund on panicle branches; glumes subequal, the keel glabrous or scabrous 12
12. Short rhizomes sometimes present or culms slightly decumbent at the base and rooting at the nodes; ligule more than 2 mm long, membranous without a ciliate fringe; inflorescence an open, flexuous panicle; lemma apex mucronate or short-awned; perennials of shaded habitats ..... 17. ***Cinna latifolia***
12. Tufted, rhizomes absent; ligules less than 1 mm long, a fringe of hairs or a short membrane with a ciliate apex; inflorescence an open or contracted, stiff panicle often remaining within the leaf sheath; lemma apex acute to rounded, awnless; annuals or perennials of open habitats ..... 54. ***Sporobolus***
13. Stems neither decumbent nor rooting at the nodes; inflorescence an open panicle (Fig. 44*a*); glumes absent; lemma awnless; upper culm nodes pubescent; exposed sheath margin ciliate; leaf blade margins strongly retrorse–scabrous ..... 61. ***Leersia oryzoides***
13. Stems decumbent and rooting at the nodes; inflorescence a contracted, spikelike panicle (Fig. 14*a*); glumes 2; lemma dorsally awned (Fig. 14*d,g,i*); upper culm nodes glabrous; exposed sheath margin glabrous; leaf blade margins not strongly retrorse–scabrous ..... 12. ***Alopecurus***
14. Inflorescence a dense spike (Fig. 27*a*); spikelets in triads (Fig. 27*e,f*); the central one fertile, usually sessile, the lateral ones pedicellate and usually sterile (Fig. 27*e,f*) (compare spikelet structure carefully with ×*Agrohordeum*, Fig. 26*g*); rachis disarticulating at the nodes; glumes setaceous or long-awned (Fig. 27*d*) ..... 33. ***Hordeum***
14. Inflorescence a panicle (sometimes compact and spikelike); spikelets not in triads; rachis disarticulating at the nodes or not; glumes acute (Figs. 33*e*, 40*d*), mucronate (Fig. 32*e*), or awned (Fig. 23*c*), but not setaceous 15
15. Rachis markedly flattened (Figs. 36*d*, 40*b*, 41*c*), winged or ridged 16
15. Rachis terete or angular without obvious wings or ridges 22
16. Spikelets in pairs, one perfect and sessile on the rachis branch, the other staminate or highly reduced on a hairy pedicel; spikelets more or less terete or somewhat angular (Figs. 35*c,d*, 36*c,f*); lower glume with 4 or more nerves, indurate 17
16. Spikelets not in pairs (except in *Digitaria* where both are short pedicellate and hermaphrodite), dorsally or laterally compressed, not angular or terete; lower glume with less than 4 nerves, not indurate 19

17. Culm nodes pubescent; inflorescence a more or less open panicle of many racemes, each with 2–5 fertile spikelets; pedicellate spikelets reduced to a pedicel, sometimes with a minute remnant; glumes rounded not obviously keeled or angled ..... 49. ***Sorghastrum nutans***

17. Culm nodes glabrous; inflorescence of 1–several spicate racemes, each with 6–10 fertile spikelets; pedicellate spikelets present, reduced but often staminate; glumes keeled 18

18. Inflorescence a panicle of 2–6 digitately arranged, spicate racemes on a peduncle (Fig. 35*a*); spathe absent; leaf sheaths not strongly keeled ..... 47. ***Andropogon***

18. Inflorescence a much branched panicle with each branch terminating in a single raceme subtended by a leafy spathe (Fig. 36*a*); leaf sheaths strongly keeled ..... 48. ***Schizachyrium scoparium***

19. Annuals; spikelets dorsoventrally compressed; glumes very unequal (Fig. 32*e,f*); lower glume as broad or broader than long (Fig. 32*e*); sterile floret present below single, fertile floret; fertile lemma coriaceous, with 5 or more nerves 20

19. Perennials; spikelets laterally compressed; glumes subequal to unequal (Figs. 40*b,d*, 41*d*); lower glume many times longer than broad; sterile or staminate florets absent below (vestigial florets without stamens or ovaries above perfect floret); fertile lemma not coriaceous, with 3 nerves ... 21

20. Ligule membranous, to 2 mm; panicle branches long, closely spaced, lower branches overlapping upper (panicle appearing digitate); spikelets in 2 distinct rows on branches; lower glume nerveless; upper glume and sterile lemma without large, stiff trichomes; sterile lemma awnless ..... 43. ***Digitaria***

20. Ligule absent; panicle branches short, lower branches not overlapping the upper; spikelets not in 2 rows on branches; lower glume 3-nerved; upper glume and sterile lemma with long, stiff trichomes, often papillose at base (Fig. 32*f,g*); sterile lemma mucronate or with terminal awn ..... 44. ***Echinochloa***

21. Spikelets obscure (Fig. 41*a*), with 1 perfect floret and no vestigial florets; ligule more than 1 mm, membranous; leaf sheaths keeled; blade folded in bud, abaxial surface glabrous ..... 57. ***Schedonnardus paniculatus***

21. Spikelets obvious (Fig. 40*a,g*), with 1 perfect floret and vestigial florets above, these often reduced to spines; ligule less than 1 mm, a fringe of hairs, sometimes on a short membrane; leaf sheaths not keeled; blade rolled in bud, abaxial surface scabrous ..... 55. ***Bouteloua***

22. Spikelets with 3 florets, the terminal one hermaphrodite, the lower two staminate; foliage with sweet smell of coumarin; inflorescence an open, pyramidal panicle ..... 20. ***Hierochloë orderata***

22. Spikelets with 1–2 florets, or if with 3, the lower two reduced and sterile; foliage without sweet smell of coumarin; inflorescence a compact or open panicle 23

23. Lemma coriaceous, harder than the glumes, closely or completely enclosing the palea 24

23. Lemma not coriaceous, similar in texture to or softer than the glumes, loosely enclosing the palea 30

24. Spikelets laterally compressed; glumes subequal, keeled, the keel sometimes with a thin membranous wing, both distinctly longer than the lemma (Fig. 21*d,f*) ..... 22. ***Phalaris***

24. Spikelets dorsoventrally compressed or not noticeably compressed; glumes equal to unequal, not keeled or winged, as long as or shorter than the lemma, rarely longer 25

25. Lemma with terminal awn; reduced florets absent; glumes subequal to equal 26
25. Lemma awnless; reduced floret in the form of a sterile lemma below the single, perfect floret; glumes very unequal 28
26. Ligule a short fringe of hairs (Fig. 40*f*); lemma awn divided into 3; palea less than one-quarter the length of the lemma; lodicules fleshy, distinctly nerved ..... 60. ***Aristida purpurea***
26. Ligule membranous, with or without hairs (Fig. 31*c*); lemma awn undivided; palea more than one-quarter the length of the lemma; lodicules membranous, nerveless 27
27. Lemma body elliptic to ovate, less than 1 cm long; lemma callus blunt; awn less than 2 cm, not strongly twisted when dry, sometimes deciduous before anthesis ..... 40. ***Oryzopsis***
27. Lemma body cylindrical, more than 1 cm long; lemma callus sharp-pointed; awn more than 2 cm, strongly twisted when dry, not deciduous ..... 41. ***Stipa***
28. Paniculate inflorescence contracted and spikelike (Fig. 34*a*); spikelets subtended by 1–several bristles that exceed the spikelet in length (Fig. 34*c,h*); disarticulation below the glumes and above the bristles ..... 46. ***Setaria***
28. Paniculate inflorescence open and diffuse; spikelets not subtended by bristles; disarticulation above or below the glumes 29
29. Plants annual with fibrous roots or perennial and strongly rhizomatous; culms without axillary branching; basal leaves similar to culm leaves, basal rosette absent; blade midrib and veins prominent on both surfaces; panicles terminal on culms; upper glume and sterile lemma sometimes apically scabrous along nerves, but otherwise glabrous ... 45. ***Panicum***
29. Plants short-lived, tufted perennials without rhizomes; culms with axillary branching; basal leaves shorter and broader than culm leaves, basal rosette produced in late summer and overwintering; blade midrib obscure, veins prominent only on the abaxial surface, obscure adaxially; terminal panicle produced first, axillary panicles produced later; upper glume and sterile lemma short pilose over entire surface (sometimes glabrous in *D. oligosanthes*) ..... 42. ***Dichanthelium***
30. Glumes strongly keeled and the keel pectinate–ciliate (Fig. 22*f*), or glumes inflated (Fig. 16*e*); lemmas awnless 31
30. Glumes not strongly keeled, the keels not pectinate–ciliate, glumes not inflated; lemmas awned or awnless 32
31. Perennials; ligules less than 5 mm, truncate (Fig. 22*e*); inflorescence a compact, spikelike panicle (Fig. 22*b*); glumes short-awned; keel ciliate (Fig. 22*f*); lemma shorter than the glumes, the apex truncate (Fig. 22*g*); anthers 1.0–2.0 mm long ..... 23. ***Phleum***
31. Annuals; ligules more than 5 mm, attenuate (Fig. 16*b,c*); inflorescence a spikelike (Fig. 16*a,d*) or open panicle; glumes acuminate but not awned; keel not ciliate (Fig. 16*e*); lemma slightly longer than glumes although much smaller in overall size, the apex acute (Fig. 16*e*); anthers 0.5–1.2 mm long ..... 15. ***Beckmannia syzigachne***
32. Glumes strongly laterally compressed, awn much longer than glume (Fig. 23*c*) arising from a bifid apex; disarticulation below the glumes; lemma about one-half the length of glumes, lemma awned from a broad apex (Fig. 23*d*) ..... 24. ***Polypogon monspeliensis***

32. Glumes rounded, but sometimes keeled especially toward the apex, awnless or awn shorter than glume body; disarticulation above the glumes; lemma more than one-half the length of glumes, lemma awnless, dorsally awned, or terminally awned from an attenuate apex 33

33. Glumes, at least the lower, distinctly shorter than the lemma (Figs. 37*c*, 38*c*); lemma 3-nerved and mucronate or awned from an entire or minutely bifid apex, or 1-nerved and awnless; plants usually with strong rhizomes 34

33. Glumes, at least the upper, longer than the lemma, or more or less equal in size (Figs. 13*c*, 17*c*); lemma (3−)5-nerved, awnless or dorsally awned (Fig. 17*d*); plants with or without rhizomes 35

34. Leaf sheath margins not ciliate; ligules membranous with erose or ciliate apex (Fig. 38*b*); leaf blades to 6 mm wide, the basal margins without hairs; lemmas less than 4 mm long, 3-nerved, scabrous, puberulent or pubescent, mucronate or with a short awn; lemma callus with or without short hairs; lodicules fleshy .... 52. ***Muhlenbergia***

34. Leaf sheath margins ciliate (Fig. 37*b*); ligule a fringe of hairs; leaf blades to 12 mm wide, the basal margins with long, silky hairs; lemmas 6.0−6.5 mm long, 1-nerved, glabrous, acute, awnless; lemma callus bearded with long, silky hairs at least half the length of the lemma (Fig. 37*d*); lodicules membranous ..... 50. ***Calamovilfa longifolia***

35. Annuals; rachilla extended as a slender, glabrous bristle; lemma less than 2.5 mm long, with 5 indistinct nerves, the awn arising subterminally but well above the middle of the lemma, 5.5−10(16) mm long, almost completely exerted from spikelet ..... 13. ***Apera interrupta***

35. Perennials; rachilla extension, when present, pubescent; lemma 1.5−5 mm long, with 3−5 strong nerves, the awn, when present, arising dorsally, just above or below the middle of the lemma (Fig. 17*d*), less than 4.5 mm long, not exerted or only partially exerted from spikelet (Fig. 17*c*) 36

36. Rachilla extension present, pubescent; upper glume 3-nerved; lemma callus bearded with long hairs more than 0.5 mm, at least reaching to base of dorsal awn (Fig. 17*d*); palea well-developed, more than three-quarters the length of the lemma ..... 16. ***Calamagrostis***

36. Rachilla extension absent; upper glume 1-nerved; lemma callus, if bearded, with short hairs less than 0.5 mm, not reaching to the base of the dorsal awn, if one is present; palea less than three-quarters the length of the lemma, sometimes absent ..... 11. ***Agrostis***

37. Inflorescence a true terminal spike (Figs. 8*a*, 25*a*,*b*) 38

37. Inflorescence a panicle, open and diffuse, or contracted and spikelike (sometimes with only one spikelet as in *Danthonia unispicata*) 48

38. Spikelets borne edgeways to rachis (Fig. 8*a*); lateral spikelets with 1 glume, terminal spikelet with 2 glumes (Fig. 8*b*) ..... 5. ***Lolium***

38. Spikelets not borne edgeways to rachis; all spikelets with 2 glumes . 39

39. Spikelets 2(−3) per rachis node 40

39. Spikelets solitary at each rachis node (sometimes 2 per node and rachis branching at lower nodes of *Agropyron smithii*, the upper nodes with solitary spikelets) 43

40. Spikelets (1), 2, or 3 per node, often variable on a single rachis, sterile; anthers abortive, or if developed, without well-formed pollen .. 41

40. Spikelets 2, or rarely 3 per node, fertile; anthers and pollen well formed 42

41. Spikelets 1–3 per node; rachis disarticulating at the nodes; lemmas usually long-awned, awn 2 cm or more ..... 30. ×*Elyhordeum* ..... 28. ×*Agrohordeum macounii*

41. Spikelets 1–2 per node; rachis not disarticulating at the nodes; lemmas usually awnless ..... 27. ×*Agroelymus*

42. Plants usually more than 50 cm high; glumes subulate to narrowly subulate, with an entire apex, the awn, if present, short, flexuous or straight, to 20 mm; rachis not disarticulating at the nodes ..... 31. *Elymus*

42. Plants less than 50 cm high; glumes subulate to lanceolate, usually with a bifid apex, the awn flexuous, (20)30–70(120) mm long; rachis disarticulating at the nodes ..... 35. *Sitanion hystrix*

43. Plants sterile; anthers abortive or without well-formed pollen 44

43. Plants fertile; pollen and anthers well formed 45

44. Spikelets 1–3 per node; rachis disarticulating at the nodes ..... 28. ×*Agrohordeum macounii*

44. Spikelets 1–2 per node; rachis not disarticulating at the nodes ..... 27. ×*Agroelymus*

45. Plants perennial; tufted or rhizomatous; native, or introduced weeds ..... 29. *Agropyron*

45. Plants annual; tufted; cultivated cereals, or introduced weeds 46

46. Spikes short, 0.8–2.0 cm; glumes inflated; lemma 5.0–7.5 mm; plants less than 4 dm high, an introduced weed of, as yet, scattered local occurrence ..... 32. *Eremopyrum triticeum*

46. Spikes long, 6–17 cm; glumes not inflated; lemma 8–16 mm; plants more than 5 dm high, cultivated or rarely escaped 47

47. Spikelets 2-flowered; glumes subulate, not indurate, 1(–3) nerves ..... 34. *Secale cereale*

47. Spikelets (2)3–5-flowered; glumes ovate, indurate, 3 or more nerves ..... 36. *Triticum*

48. Ligule a fringe of hairs, or a fringed membrane with hairs longer than the membrane (Figs. 3*j*,*l*, 4*d*) 49

48. Ligule always membranous, with hairs, if present, shorter than the membrane (Figs. 3*h*,*i*,*k*, 4*a*,*b*,*c*) 53

49. Spikelets sessile and secund on panicle branches (Figs. 40*a*,*b*,*g*), with 1 perfect floret and 1 or more highly reduced or vestigial florets (Fig. 40*c*) ..... 55. *Bouteloua*

49. Spikelets subsessile or pedicled and not secund on panicle branches, with more than one perfect floret 50

50. Annuals with prostrate or decumbent stems; ligule without membranous tissue; upper glume less than 5 mm long; lemma 3-nerved; lemma callus not bearded 51

50. Erect perennials; ligule usually with basal membranous tissue; upper glume more than 5 mm long; lemma 5 or more nerves; lemma callus bearded 52

51. Leaves in tight clusters (fascicles) along prostrate stems; blades stiff, pungent, and with white margins; reduced panicles hidden in fascicles of leaves; spikelets few-flowered, the lower with 3–4 flowers, the upper with 2–3 flowers; lower glume reduced or absent in upper spikelets; upper glume 2.5–4.5 mm; lemma with hairy tufts on lateral nerves, midvein extending into a short awn ..... 53. *Munroa squarrosa*

51. Leaves not in fascicles; blades not stiff or pungent, without white margins; panicles large and open, not reduced or hidden among leaves; spikelets 3–many-flowered; lower glume unequal but never absent; upper glume to 2.5 mm; lemma glabrous, awnless ..... 51. ***Eragrostis***
    52. Tufted perennials to 1 m high; panicle contracted, usually with fewer than 10 spikelets; first floret with 3 stamens (sometimes aborted); glumes longer than the lemma and enclosing spikelet; lemma with 7 or more nerves; awn twisted, inserted dorsally just below notch of bifid apex; lemma callus bearded with hairs less than one-half the length of the lemma, rachilla glabrous, scabrous, or with short pubescence ..... 64. ***Danthonia***
    52. Strongly rhizomatous perennials 2–3 m high; panicle diffuse, with many spikelets; first floret with 1(–2) stamen(s); glumes shorter than lemma and not enclosing spikelet; lemma 5-nerved, usually awned terminally from an entire apex; lemma callus and rachilla bearded with hairs as long as or longer than the lemma ..... 63. ***Phragmites australis***
53. Spikelets with (1–)2(–3) florets, (1–6 florets in *Helictotrichon hookeri*, but lemma with a distinctly dorsal, twisted awn, Fig. 19*d*); upper glume as long as or distinctly longer than first lemma; rachilla, if prolonged above perfect florets, without reduced or vestigial florets; lemma with or without a dorsal, twisted, geniculate awn (Figs. 14*d,g*, 15*c,e*) 54
53. Spikelets with 3–many florets (1–2 florets per spikelet depauperate specimens); upper glume shorter than first lemma (the first lemma sometimes slightly longer than the upper glume in *Sphenopholis*); rachilla, if prolonged above perfect florets, usually with reduced or vestigial florets; lemma with or without a terminal, straight or curving (not twisted or geniculate) awn (Figs. 7*f*, 12*e*) 61
    54. Lemma awned dorsally, the awn twisted and geniculate 55
    54. Lemma awnless, the apex rarely mucronate 58
55. Spikelets large, 12 mm or more; glumes 12 mm or more 56
55. Spikelets smaller, to 12 mm; the upper glume 7 mm or less 57
    56. Perennials; leaf sheaths keeled; panicles contracted and spikelike (Fig. 19*a*); 3–7 florets per spikelet; glumes 12–15 mm, shorter than spikelet ..... 19. ***Helictotrichon hookeri***
    56. Annuals; leaf sheaths not keeled; panicles open and diffuse (Fig. 15*a*); 2(–3) florets per spikelet; glumes 20 mm or more, as long as the spikelet ..... 14. ***Avena***
57. Ligule elongate, attenuate, to 10 mm; lemma rounded on back, less than 4(4.5) mm with a more or less truncate and erose apex, awned from below the middle; endosperm granular ..... 18. ***Deschampsia***
57. Ligule broadly truncate and erose at the apex, to 5 mm; lemma laterally compressed and keeled, 4–6 mm, with an acute, usually bifid apex, awned from above the middle and below the bifid notch; endosperm liquid ..... 26. ***Trisetum***
    58. Glumes unequal in size and shape, the lower narrow, lanceolate, the upper longer, broader, obovate, or oblanceolate (Fig. 24*c,e,g*), 2–3 mm; disarticulation below the glumes, the spikelet falling as a unit ..... 25. ***Sphenopholis***
    58. Glumes subequal, the upper larger than the lower but similar in shape, not oblanceolate, 3 mm or more; disarticulation above the glumes and between the florets 59

59. Plants with stout rhizomes (Fig. 11*b*); panicle open and diffuse (Fig. 11*a*); spikelets usually with (2−)3−4 florets (Fig. 11*e*); lemma callus bearded, with hairs 1.0−1.5 mm long ..... 8. ***Scolochloa festucaceae***

59. Plants tufted, without rhizomes; panicle more or less contracted and spikelike (Fig. 20*a*,*b*); spikelets usually with 2(−3) florets; lemma callus glabrous or sparsely puberulent 60

60. Culms not decumbent or rooting at nodes, or only weakly so; leaves mostly basal; ligules 0.5−1.5(−2) mm; blades usually folded or involute, 1−2(2.5) mm wide; glumes less than 5 mm; anthers 1.2−2.4 mm; ovary apex glabrous; widespread in open rangeland ..... 21. ***Koeleria macrantha***

60. Culms strongly decumbent and rooting at nodes (sometimes with short rhizomes); leaves mostly cauline; ligules 1.2−4.5(−6) mm; blades flat, 2−5(−7) mm wide; glumes more than 5 mm; anthers 0.6−1.2 mm; ovary apex pubescent; restricted to moist meadows and woods in middle and subalpine elevations, Cypress Hills, and southern Rocky Mountains ..... 26. ***Trisetum wolfii***

61. Lemmas tapering smoothly to an acute apex (Fig. 11*d*,*e*), with a terminal awn or mucro (Figs. 7*f*, 12*e*), without a band of anthocyanin pigment in the upper part, the margins more or less straight and parallel, the back rounded without a keel or keel obscure (except *Dactylis*) 62

61. Lemmas broader, rounded, obtuse, or broadly acute at the apex, without an awn or mucro (Figs. 9*g*,*h*, 10*e*,*g*), sometimes with a band of anthocyanin pigment in the upper part, the margins straight or curved, the back rounded or keeled 68

62. Leaves mostly cauline; plants small with fibrous roots; annuals 63

62. Leaves mostly basal; plants of various sizes, either tufted or rhizomatous; perennials 64

63. Inflorescence an open panicle; first glume less than one-half the first lemma; lemmas acute, awnless; anthers 3 per floret; flowers chasmogamous; introduced weed known only from Brandon, Manitoba ..... 3. ***Eremopoa persica***

63. Inflorescence a spike or contracted, spikelike panicle; first glume more than one-half the length of the first lemma; lemmas terminally awned; anthers 1 (rarely 3) per floret; flowers mostly cleistogamous; native and widespread ..... 10. ***Vulpia octoflora***

64. Lemma callus bearded 65

64. Lemma callus not bearded 66

65. Lemma callus bearded with straight hairs, 1.0−1.5 mm (Fig. 11*e*); glumes lanceolate, the upper more than 6 mm (Fig. 11*d*); rachilla not prolonged above uppermost fertile floret; lemmas 7−9-nerved; leaf blades without 2 light lines of bulliform cells; ovary apex pubescent (Fig. 11*g*) ..... 8. ***Scolochloa festucacea***

65. Lemma callus bearded with crinkled hairs more than 1.5 mm forming a webby tuft; glumes broader, acute to obtuse, the upper less than 6 mm (Fig. 9*f*); rachilla usually prolonged beyond the uppermost fertile floret and bearing vestigial florets; lemmas usually 5-nerved; leaf blades with 2 light lines of bulliform cells, one on either side of the midvein (Fig. 9*d*); ovary apex glabrous ..... 6. ***Poa***

66. Leaf sheaths keeled; spikelets usually with 3 florets, in globose to elliptic fascicles that are crowded at the ends of long panicle branches; spikelets and fascicles appearing secund, arising from two sides of the

three-sided rachis branches on short pedicels; hay crop, relatively rare in rangelands ..... 2. ***Dactylis glomerata***

66. Leaf sheaths not keeled; spikelets usually with more than 3 florets, not in fascicles, not appearing secund, usually on long pedicels; widespread as rangeland forage grasses 67

67. Leaves lacking 2 light lines of bulliform cells, not boat-tipped; ligule less than 1 mm, apex ciliate; lemma apex attenuate, awned or mucronate ..... 4. ***Festuca***

67. Leaves with 2 light lines of bulliform cells, one on either side of the midvein, boat-tipped (Fig. 3*e*); ligule usually more than 1 mm; apex not ciliate; lemma apex obtuse to acute, without an awn or mucro ..... 6. ***Poa***

68. Leaf tips pointed but not boat-shaped (Fig. 3*d*); glumes unequal (Fig. 10*d*); lemmas broadly obtuse to rounded (Fig. 10*e,g*), erose at apex; veins parallel, not converging toward the lemma apex, callus not bearded 69

68. Leaf tips boat-shaped (Figs. 9*c*, 20*d*); glumes subequal (Figs. 9*f*, 20*f*); lemmas acute, acutish, or rounded (Figs. 9*g*, 20*g*); veins not parallel, converging toward the lemma apex, callus not bearded or with a webby tuft 70

69. Rhizomes present; leaves flat and relatively wide, 4−8 mm; lemma short, scabrid on back although mainly on the distinct nerves; plants of nonsaline, neutral, or slightly acid habitats .... 9. ***Torreyochloa pallida***

69. Rhizomes absent; leaves involute or flat, relatively thin if flat, 0.3−3(5) mm wide; lemma pubescent basally; nerves indistinct; plants of saline or alkaline habitats ..... 7. ***Puccinellia***

70. Tufted perennials without rhizomes; sheaths open to the base; spikelets usually (1−)2(−4)-flowered (Fig. 20); lemma callus not bearded; lemma without anthocyanin band apically; apex acute or mucronate (Fig. 20*g*); rachilla prolonged beyond the uppermost fertile floret as a bristle ..... 21. ***Koeleria macrantha***

70. Tufted or rhizomatous perennials (*P. annua* is annual); sheaths open about two-thirds the length of the internode, closed near the base; spikelets usually more than 2-flowered; lemma callus glabrous or with a webby beard of crinkled hairs; lemma with a band of anthocyanin pigment between the middle of the lemma and the apex (this sometimes obscure); apex obtuse, rounded, or subacute (Fig. 9*g,h*); rachilla prolonged above the uppermost fertile floret but always with reduced vestigial flowers ..... 6. ***Poa***

Generic descriptions

Tribe Poeae

1. *Bromus* L.

Fig. 6

Annuals and perennials, usually to 1 m high, with or without rhizomes. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths closed nearly to the top; margins not overlapping;

ligules membranous, entire or lacerate, 1–2 mm long, occasionally less; auricles rudimentary, deciduous, or absent; collars variable; blades rolled in bud, flat, with or without trichomes or scabrous projections, the vestiture often variable between the basal and upper leaves on the same culm.

Inflorescence a loose panicle. Spikelets exceeding 1 cm in length, pedicellate, laterally compressed, disarticulating above the glumes and between the 3–many florets; rachilla prolonged beyond the uppermost fertile floret. Glumes subequal, shorter than the lemmas of the proximal florets, acute, with or without a keel; lower glumes 1–3-nerved; upper glumes 3–5-nerved. Lemmas rounded or keeled on the back, glabrous or pubescent, with 5 nerves converging toward the apex, with or without a single, straight awn from an apical notch. Paleas almost as long as the lemmas, keeled and pubescent at the 2 nerves, adhering to the caryopsis. Lodicules 2, fleshy or membranous without teeth or trichomes. Anthers 3. Ovary apex pubescent; styles free to the base; stigmas white. $x = 7$.

Bromus anomalus Rupr. ex E. Fourn., (including *B. porteri* Nash), *B. carinatus* Hooker & Arnott, *B. ciliatus* L. [*B. canadensis* Michaux], *B. inermis* Leysser, *B. japonicus* Thunber, *B. kalmii* A. Gray, *B. mollis* L., *B. pumpellianus* Scribner, *B. squarrosus* L., *B. tectorum* L., *B. vulgaris* (Hooker) Shear.

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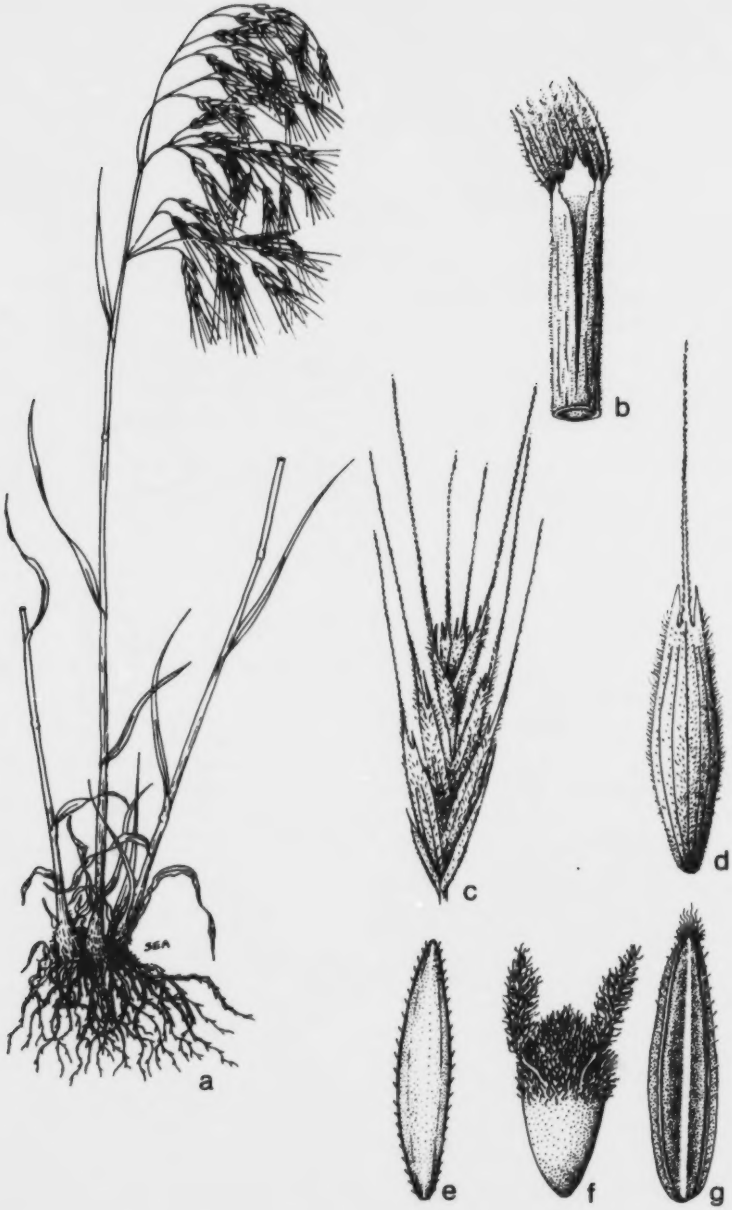
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Fig. 6. *Bromus tectorum*. (*a*) Whole plant, tufted, with basal and culm leaves flat and pubescent; inflorescence an open, drooping panicle. Approximately 0.3×. (*b*) Junction of the sheath and the blade with culm removed; ligule lacerate; sheath margins not overlapping but fused along the lower two-thirds of the sheath; sheath and lamina pubescent on the exposed surfaces. Approximately 5×. (*c*) Spikelets with 8 florets; glumes unequal, slightly keeled and pubescent on the keels; lemma awns conspicuous, scabrous, and straight. Approximately 3×. (*d*) Dorsal view of lemma showing awn arising from an apical notch, a rounded back, 5 nerves that extend almost the full length of the lemma, and pubescence that is more pronounced on the margins. Approximately 6×. (*e*) Palea at flowering, almost as long as the lemma, keeled at the 2 nerves; ciliate on the keels. Approximately 6×. (*f*) Gynoecium at flowering; ovary apex hairy; stigmas feathery almost to the base; styles free. Approximately 20×. (*g*) Palea adhering to the mature caryopsis due to a gelatinous pericarp; in this view the caryopsis is concave with a characteristic central groove. Approximately 6×.

2. *Dactylis* L.

Tufted perennials 30–120 cm high. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths open, keeled, glabrous, scabrous or pubescent; margins fused to at least one quarter of their length; ligules membranous, lacerate, 4–10 mm long; auricles absent; collars distinct, divided; blades folded in bud, flat 4–8 mm wide, hairless; surfaces with or without scabrous projections; margins scabrous.

Inflorescence an open panicle, asymmetric; spikelets flattened and crowded in dense asymmetric groups at the ends of stiff branches that are scabrous along 3 ridges. Spikelets laterally compressed, disarticulating above the glumes and between 2–5 florets; rachilla glabrous on the side adjacent to a floret, pubescent on the opposite surface, prolonged beyond the uppermost fertile floret. Glumes subequal or unequal, pubescent or stiffly ciliate on the keel and exposed margins; lower glumes 1-nerved; upper glumes 1–3-nerved. Lemmas acute, with 5 nerves converging toward the short-awned or mucronate apex, varying from ciliate to pubescent to scabrous or glabrous on the keel. Paleas almost as long as the lemmas, green, keeled, with fine hairs on the 2 nerves. Lodicules 2, free, distally membranous, toothed, glabrous. Anthers 3, yellow. Ovary apex glabrous; styles free to the base; stigmas white. $x = 7$.

Dactylis glomerata L. An introduced species that is grown extensively under irrigation for hay. It commonly escapes and will persist where conditions are suitably moist, such as the edges of roadside ditches. It is cultivated in the western provinces, but rarely in Manitoba and Saskatchewan.

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3. *Eremopoa* Roshev.

Introduced annuals, pale green, tufted, to 25 cm high. Culms glabrous; nodes sometimes exposed; upper culm internodes hollow. Sheaths open, glabrous; margins overlapping, hyaline; ligules membranous, entire, to 3 mm long; auricles absent; collars indistinct, divided, pale green; blades folded in bud, flat, up to 2 mm wide; surfaces glabrous or sparsely pubescent; margins scabrous.

Inflorescence an open panicle more than half the height of the plant, with prominent, scabrous, capillary branches. Spikelets laterally compressed, disarticulating above the glumes and between the (2–)3–4 florets; rachilla pubescent, prolonged beyond the uppermost fertile floret. Glumes unequal, acute, scabrous hairs on the central, slightly keeled nerve; lower glumes 1-nerved, about half the size of the upper glumes, these 3-nerved, approximately two-thirds of the lemma length. Lemmas acute to mucronate, 5-nerved, pubescent on the slightly keeled central nerve, the lateral nerves extending two-thirds of the lemma length, not converging. Paleas slightly shorter than the lemmas, green, keeled, with fine, stiff trichomes on the abaxial surface at the 2 nerves. Lodicules 2, free, membranous, glabrous, with toothed margins. Anthers 3. Ovary apex glabrous; styles free to the base; stigmas white.

Eremopoa persica (Trin.) Roshev. is a weedy annual grass from Central Asia that was first collected in 1955 at the Canadian National Railway freight yards at Brandon, Man. (Stevenson 1957). It was not found by the authors at Stevenson's site in 1982.

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4. *Festuca* L.

Fig. 7

Perennials 10–150 cm high, with bunchgrass habit or sometimes with slender rhizomes. Culms usually glabrous; nodes surrounded by sheaths or exposed; upper culm internodes hollow. Sheaths usually open, glabrous; margins overlapping, usually hyaline; ligule membranous, usually ciliate or erose–ciliate on the margin, to 1 mm long; auricles absent, erect, or clawlike; collars usually indistinct; blades folded in bud, flat or setaceous, usually less than 0.5 mm wide; upper surface pubescent, scabrous, or glabrous, lower surface scabrous or glabrous.

Inflorescence an open or contracted panicle. Spikelets laterally compressed, disarticulating above the glumes and between the (2)3–many florets; rachilla usually pubescent or scabrous at least on the side away from the adjacent floret, prolonged beyond the uppermost fertile floret. Glumes acute, subequal or unequal, shorter than the spikelet; lower glumes 1-nerved and sometimes keeled; upper glumes 1–3-nerved, often rounded on the back. Lemmas rounded at least at the base, sometimes keeled toward the apex, densely pubescent to glabrous, with or without a short, straight awn that arises dorsally near an acute apex (never from an apical notch, as is found in *Bromus*), 5-nerved, the lateral nerves converging but usually not extending to the apex. Paleas as long as or longer than the lemmas, green, keeled, often puberulent at the 2 nerves, not adhering to the caryopsis. Lodicules 2, free, distally membranous, with toothed margins, with or without trichomes. Anthers 3, yellow or purple. Ovary apex glabrous or pubescent; styles free to the base; stigmas white. $x = 7$.

Festuca altaica Trin., *F. arundinacea* Schreber, *F. campestris* Rydb., ["*F. doreana* Loom.," *F. scabrella* Torrey pro parte], *F. hallii* (Vasey) Piper [*F. scabrella* Torrey pro parte], *F. idahoensis* Elmer [*F. occidentalis* var. *ingrata* (Hackel) Boivin, *F. ovina* var. *ingrata* Hackel ex Beal], *F. occidentalis* Hooker, *F. ovina* L. sensu lato, *F. pratensis* Hudson [*F. elatior* L.], *F. rubra* L., *F. saximontana* Rydb., *F. viridula* Vasey.

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Fig. 7. *Festuca campestris.* (*a*) Plant base, tufted with leaf sheaths from previous season's growth, current season's leaves that are mainly basal, few leaves on the culms; blades setaceous with margins inrolled. Approximately 0.7×. (*b*) Whole plant, caespitose, bunchgrass habit. Approximately 0.3×. (*c*) Section of loose paniculate inflorescence; rachis and rachis branches glabrous. Approximately 0.8×. (*d*) Spikelet with 5 florets; glumes subequal, glabrous. Approximately 0.8×. (*e*) Junction of the leaf sheath and blade; sheath open with margins overlapping; ligule less than 0.5 mm, membranous, lacerate, with a fringe of hairs; blade scaberulous, with inrolled margins. Approximately 10×. (*f*) Lemma, with 5 veins that extend almost the length of the lemma and converge toward the base of the entire apex and apical awn; lemma surface with scaberulous projections. Approximately 10×. (*g*) Gynoecium at flowering; ovary apex with a few stiff hairs; styles free; stigmas extend almost to the base of styles.

5. *Lolium* L.

Fig. 8

Annuals or short-lived perennials 30−100 cm, with or without rhizomes. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths open, glabrous; margins overlapping, usually hyaline; ligules membranous, lacerate or entire, usually 1−2 mm long; auricles when present, clawlike, often rudimentary or absent; collars variable; blades rolled or folded in bud, flat, 2−8 mm wide; adaxial surface scabrous or glabrous; margins scabrous.

Inflorescence a simple spike with flattened spikelets borne singly at the nodes on alternate sides of the hollowed rachis. Spikelets laterally compressed, disarticulating above the glumes and between the 4−10 florets. Lower glumes absent except in the terminal spikelet; upper glumes present, almost as long as or longer than the adjacent lemma, firm, 5−7-nerved, blunt, awnless. Lemmas rounded on the back and at the apex, 5-nerved, the lateral nerves not extending for the length of the lemma or converging toward the apex, with or without a single, short straight awn. Paleas as long as or longer than the lemmas, green, puberulent and keeled at the 2 nerves. Lodicules 2, free, membranous, glabrous, with or without toothed margins. Anthers 3. Ovary apex glabrous; styles free to the base; stigmas white. $x = 7$.

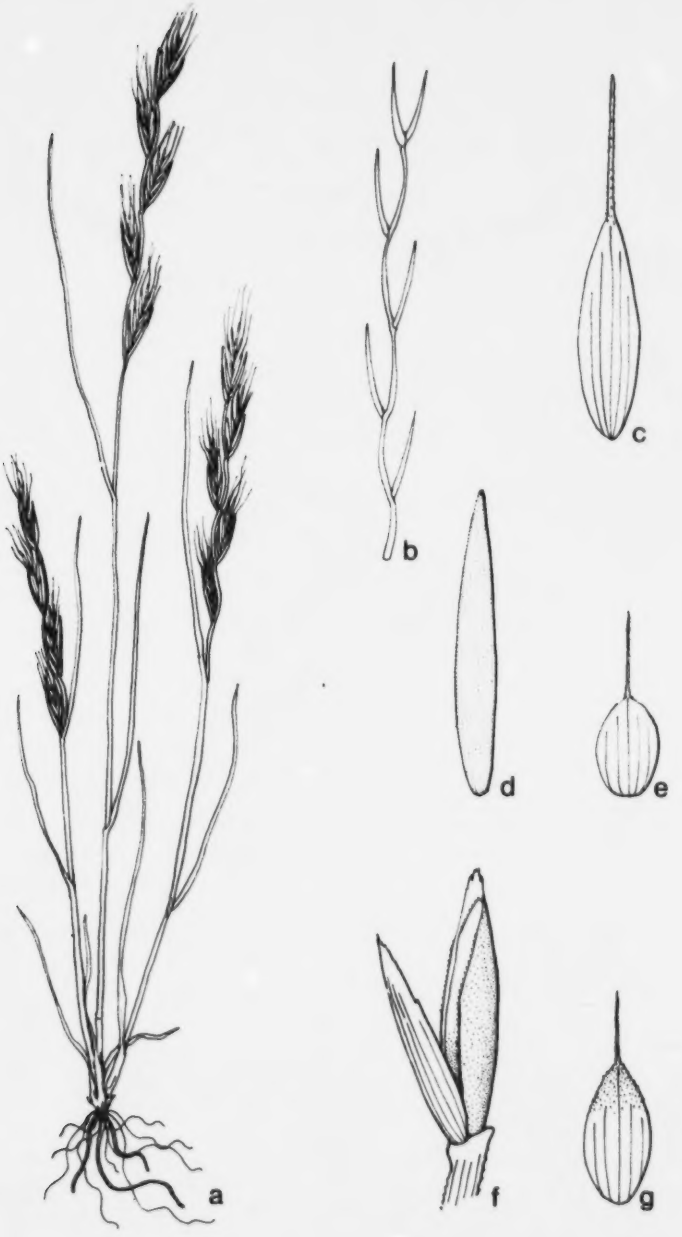
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Fig. 8. *Lolium*. (*a*–*c*) *L. persicum*. (*a*) Whole plant, tufted; leaves flat, mostly borne on the culms; inflorescence a simple spike, with laterally compressed spikelets appressed to the rachis internodes. Approximately 0.5×. (*b*) Rachis after spikelet dehiscence; terminal spikelet with 2 glumes, all others with a single, dorsally rounded glume with 5–7 nerves; rachis concave adjacent to each spikelet. Approximately 1.1×. (*c*) Lemma, with 5 parallel veins not converging at the base of the single, straight awn that arises at the entire apex. Approximately 7×. (*d*, *e*) *L. temulentum*. (*d*) Mature glume, glabrous, firmer than the lemma, only slightly dorsally rounded, with approximately 10 faint nerves that are parallel to the acute apex. Approximately 2×. (*e*) Lemma, with 5 parallel veins. Approximately 3×. (*f*) *L. perenne*. Glume and basal floret; glume (*left*) shorter than floret, in which the palea (*center*) is almost as long as the awnless lemma (*right*). Approximately 4×. (*g*) *L. perenne* var. *italicum*. Lemma, with a short, straight awn. Approximately 4×.

Key to western rangeland species

1. Upper glumes shorter than spikelet; awns absent or less than 0.5 cm long ..... ***L. perenne*** L. (including ***L. multiflorum*** Lam.)
1. Upper glumes as long as or longer than spikelet; awns 0.5–1.2 cm long.
   2. Mature glumes herbaceous; florets narrow, 3–4 times as long as wide ..... ***L. persicum*** Boiss. & Hohen.
   2. Mature glumes indurate; florets broad, about twice as long as wide .... ***L. temulentum*** L.

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6. *Poa* L.

Fig. 9

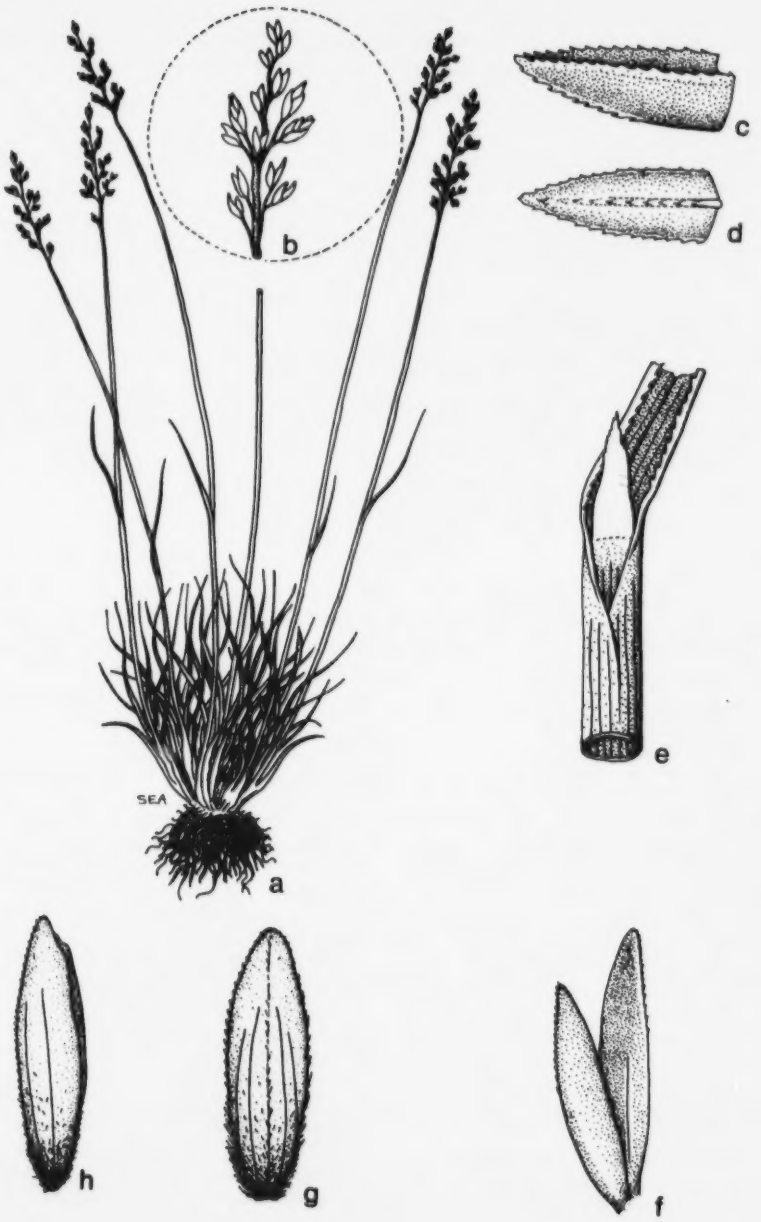
Annuals or perennials 10–100 cm high, tufted, bunchgrass habit, or with rhizomes or stolons. Culms glabrous; nodes usually exposed; upper culm internodes hollow. Sheaths partly closed basally, usually glabrous; margins overlapping, usually hyaline; ligules membranous, usually entire, usually 2 mm or less, occasionally to 5 mm long; auricles

absent; collars glabrous, often indistinct, usually divided, pale green; blades folded in bud, flat or remaining permanently folded, sometimes setaceous, 0.5 cm wide or less, with 2 rows of bulliform cells that result in a lighter-colored line on either side of the midvein, other veins usually more obscure; blade tips boat-shaped; blades glabrous or with scabrous projections on both surfaces, hairless; margins usually scabrous.

Inflorescence an open or contracted panicle, sometimes spikelike. Spikelets relatively small, 3–11 mm long, laterally compressed, disarticulating above the glumes and between the 2–5 florets. Florets awnless, usually perfect, but often partially or completely dioecious plants occurring with pistillate flowers bearing only vestigial stamens; rachilla prolonged beyond the uppermost fertile floret. Glumes subequal, relatively broad at the base, tapering to an acute apex, usually shorter than the adjacent lemma, keeled or merely laterally compressed, often with scabrous trichomes on the midvein; lower glumes shorter, 1(–3)-nerved; upper glumes 3-nerved. Lemma callus pubescence variable, often with cobwebby hairs; lemmas 5-nerved, the lateral nerves converging but becoming obscure toward the acute or rounded apex, keeled or rounded on the back, often pubescent or scabrous. Paleas from half as long to as long as the lemmas, green or colorless, keeled, and usually pubescent at the 2 nerves. Lodicules 2, free, 0.4–1 mm long, distally membranous, without trichomes, with or without toothed margins. Anthers 3. Ovary apex glabrous; styles free to the base; stigmas white. $x = 7$.

Poa ampla Merr., *P. annua* L., *P. arida* Vasey [*P. fendleriana* var. *arida* M. E. Jones], *P. canbyi* (Scribner) Howell [*P. sandbergii* sensu Fernald, 1925], *P. compressa* L., *P. cusickii* Vasey [*P. subaristata* Scribner], *P.*

Fig. 9. *Poa sandbergii*. (*a*) Whole plant, caespitose with prominent leaf bases from previous season's growth; leaves setaceous, mostly basal; inflorescence paniculate. Approximately 0.25×. (*b*) Late season inflorescence, after partial disarticulation has occurred above the subequal glumes, some spikelets with 1–3 florets. Approximately 2×. (*c*) Side view of leaf blade showing boat-shaped tip with scabrous projections on the margins and the keel, elsewhere glabrous. Approximately 30×. (*d*) Adaxial leaf surface showing two lines of colorless bulliform cells on either side of the main veins, and scabrous projections between these lines. Approximately 30×. (*e*) Junction of the leaf sheath and the blade; sheath glabrous, open with margins overlapping; ligule acute, entire; blade with scabrous projections on adaxial surface. Approximately 15×. (*f*) Subequal glumes, laterally compressed, with scabrous projections along the central veins, elsewhere glabrous. Approximately 10×. (*g*) Dorsal view of lemma showing hairs that are longer and more abundant toward the base of the lemma, but not organized as a callus; hairs shorter or merely puberulent toward the apex; 5-nerved, the lateral nerves not extending the length of the lemma but tending to converge toward the center. Approximately 10×. (*h*) Lateral view of lemma showing acute apex and only slightly keeled midvein.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fendleriana (Steudel) Vasey, *P. glaucifolia* Scribner & T. R. Williams, *P. gracillima* Vasey, *P. juncifolia* Scribner, *P. interior* Rydb. [*P. nemoralis* var. *interior* (Rydb.) Butters & Abbe], *P. nervosa* (Hooker) Vasey, *P. palustris* L., *P. pratensis* L., *P. sandbergii* Vasey [*P. secunda* Presl], *P. trivalis* L.

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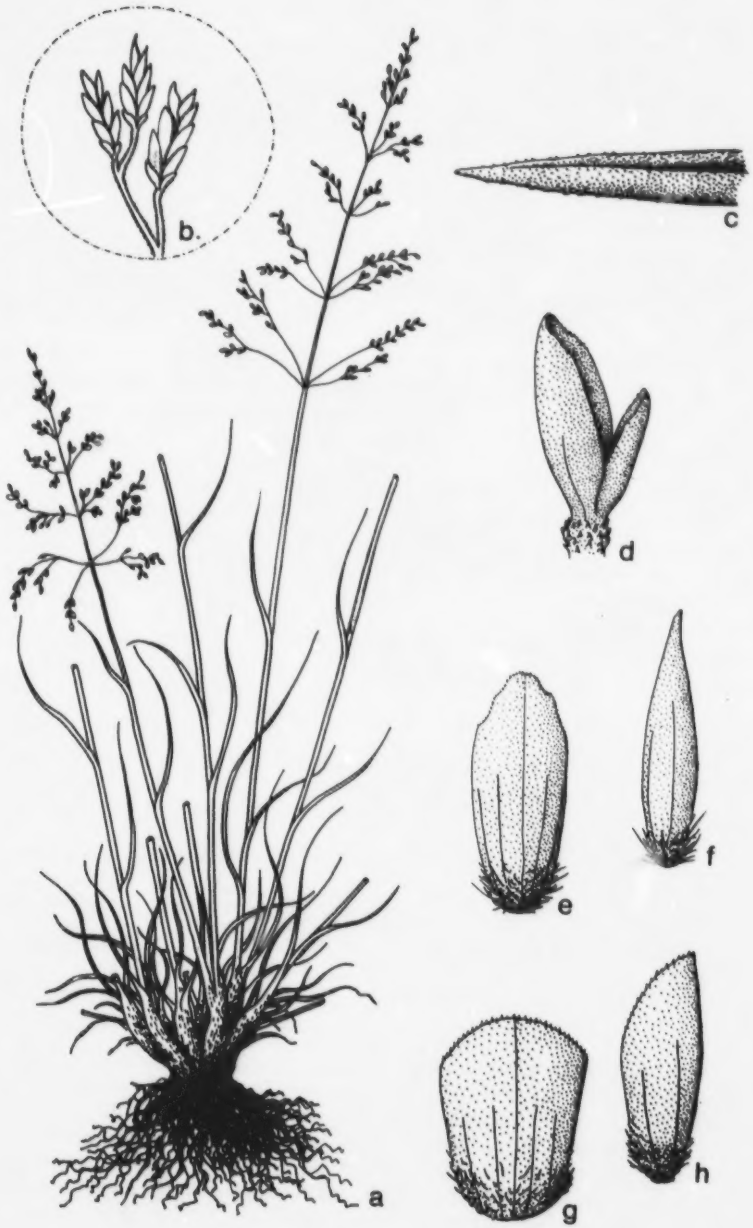
7. *Puccinellia* Parl.

Fig. 10

Low, tufted perennials, without rhizomes. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths open; margins overlapping, hyaline, glabrous, and extended as sheath auricles; ligules membranous, entire, less than 3 mm long; collars indistinct, divided; blades hairless; adaxial surface scabrous, abaxial surface glabrous; margins scabrous.

Fig. 10. *Puccinellia*. (*a*–*e*) *P. nuttalliana*. (*a*) Whole plant, caespitose, leaf sheaths from previous season's growth persistent; leaves mostly basal; blades flat or, more often, rolled and setaceous; inflorescence open, pyramidal panicles with widely divergent branches; spikelets borne from the middle toward the distal half of the lower branches. Approximately 0.2×. (*b*) A group of 3 spikelets; rachis with prominent scabrous projections; spikelets with many flowers. Approximately 2.5×. (*c*) Leaf blade apex; blade rolled in bud, often remaining rolled, tapering to a point; main blade veins uniform in thickness without rows of bulliform cells. Approximately 15×. (*d*) Glumes rounded on the back, glabrous, with a minutely erose apex; 1–3 nerves, lateral ones when present not extending for the length of the glume; rachis scabrous. Approximately 20×. (*e*) Dorsal view of lemma showing basal pubescence and 5 nerves, the lateral ones not extending the length of the lemma and tending to diverge slightly from the central nerve; apex rounded, obtuse, minutely erose. (*f*) Lateral view of lemma; lemma appearing to taper to an acute apex. Approximately 15×. (*g*, *h*) *P. distans*. Lemma approximately 10×. (*g*) Dorsal view showing hairy callus and 5 nerves, the lateral ones diverging from the central nerve and not extending to the rounded, erose apex. (*h*) Lateral view of lemma; apex broadly rounded, ovate to truncate, and erose–ciliate.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Inflorescence an open panicle. Spikelets laterally compressed, disarticulating above the glumes and between the 3–7 awnless florets; rachilla glabrous, prolonged beyond the uppermost fertile floret. Glumes unequal, glabrous, the lower glume 1-nerved, the upper glume 3-nerved. Lemmas rounded on the back, pubescent basally, otherwise glabrous; 5-nerved, the lateral nerves diverging or parallel, not extending to the apex; callus glabrous or short pubescent. Paleas approximately the length of the lemmas, keeled and pubescent at the 2 nerves. Lodicules 2, free, distally membranous, each with a marginal tooth, without trichomes. Ovary apex glabrous; styles free to the base; stigmas plumose, white. $x = 7$.

Puccinellia distans (Jacq.) Parl., *P. nuttalliana* (J. A. Schultes) A. S. Hitchc. [*P. airoides* (Nutt.) Wats. & Coulter; including *P. cusickii* Weatherby].

Plants of the sterile hybrid *P. nuttalliana* × *distans* are frequently found in southern Manitoba where both parents are abundant (Dore and McNeill 1980).

Maher et al. (1979) suggest that *P. lemmonii* (Vasey) Scribner occurs in Alberta and Saskatchewan, but the Canadian specimens labeled *P. lemmonii* at the Canadian National Museum, presumably the basis for the record, are all referable to *P. nuttalliana*, with leaves more than 0.5 mm wide scattered on erect culms. *P. lemmonii* specimens from the United States are caespitose, with setaceous leaves less than 0.5 mm wide. The recorded distribution of this species in the United States does not extend as far north as the Canadian border (Cronquist et al. 1977).

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Characters to distinguish *Poa* from *Puccinellia*

Character	*Poa*	*Puccinellia*
Leaf sheath	Margins fused toward the base.	Margins free to the base.
Upper surface of leaf blade	With 2 median lines of bulbous cells that are lighter in color on either side of the midvein.	No distinct bulliform cells in lines.
Leaf tip	Boat-shaped, blade keeled (Fig. 9*c*,*d*).	Tapering to a rounded point. Blade not keeled (Fig. 10*c*).
Lamina in bud	Folded.	Rolled.
Glumes	Relatively soft, acute, keeled, or with the suggestion of a keel.	Firm, rounded on the back, no suggestion of a keel.
Glume size	Subequal: the lower glume more than half the size of the upper glume, but not as large.	Unequal: the lower glume less than half the size of the upper glume.
Lemma apex	Usually scarious at the apex.	Often erose–ciliate at the apex, or entire.
Lemma nerves	Converge toward the apex.	Nerves do not converge.
Palea	Colored or colorless on the 2 veins.	Colored at the 2 veins.

8. *Scolochloa* Link

Fig. 11

Perennials 1–1.5 m high, with long, stout rhizomes, to 0.5 cm in diameter. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths open, glabrous; margins overlapping, hyaline, extended as sheath auricles; ligules membranous, lacerate, 5–10 mm long; collars distinct, continuous or divided, yellowish; blades rolled in bud, becoming flat, 0.5–1 cm wide, glabrous or sometimes abaxially pubescent; margins scabrous.

Inflorescence an open panicle. Spikelets laterally compressed, disarticulating above the glumes and between the 3–4 florets; rachilla pubescent, prolonged beyond the uppermost fertile floret. Glumes subequal, acute or mucronate, slightly keeled on the back, glabrous or scaberulous; lower glumes 1–3-nerved; upper glumes 3–5-nerved. Lemma callus bearded with a tuft of hairs; lemmas acute, rounded on the back, scaberulous, with 5–7 nerves that converge toward the

Fig. 11. *Scolochloa festucacea*. (*a*) Whole plant. Approximately 0.16×. (*b*) Plant base, strongly rhizomatous. Approximately 0.5×. (*c*) Junction of the leaf sheath and blade; ligules membranous, lacerate, and extending into the auricle position; blade margins scabrous; sheath glabrous. Approximately 5×. (*d*) Spikelet with subequal glumes and 4 awnless florets. Approximately 6×. (*e*) Floret with lemma callus bearded and a palea (*right*) that is almost as long as the lemma. Approximately 8×. (*f*) Lodicules, membranous, with toothed margins. Approximately 20×. (*g*) Gynoecium apex stiffly ciliate; styles free to the base. Approximately 20×.

mucronate apex. Paleas almost as long as the lemmas, green, pubescent and keeled at the 2 nerves. Lodicules 2, free, membranous, without trichomes, with or without toothed margins. Anthers 3, yellow. Ovary apex stiffly ciliate; styles free to the base; stigmas white. $x = 7$.

Scolochloa festucacea (Willd.) Link. Found throughout Western Canada in marshes and shallow water. The only North American species in the genus.

9. *Torreyochloa* Church

Perennials of wet, nonsaline habitats, 30–100 cm high, with procumbent culms rooting at the nodes. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths open, glabrous; margins overlapping, hyaline; ligule membranous, scabrous abaxially, usually lacerate, continuous with sheath auricles, 3–5 mm long; collars indistinct, glabrous, yellow; blades rolled at emergence, becoming flat, 4–8 mm wide; surfaces puberulent; margins scaberulous.

Inflorescence an open panicle; rachis scabrous. Spikelets of 3–8 awnless florets, laterally compressed, disarticulating above the glumes and between the florets; rachilla scabrous, extended beyond the uppermost fertile floret. Glumes unequal, shorter than the adjacent lemma, dorsally rounded, glabrous, the lower glume 1-nerved, the upper glume 3-nerved. Fertile lemmas acute, rounded and scaberulous on the back, the 5 prominent nerves more or less parallel. Paleas slightly shorter than the lemmas, keeled and pubescent on the 2 nerves. Lodicules 2, free, glabrous, membranous, toothed. Ovary apex with a few minute cilia clearly visible at 40×; styles free to the base; stigmas white. $x = 7$.

Torreyochloa pallida (Torrey) Church [*Glyceria pallida* (Torrey) Trin.; *Puccinellia pallida* (Torrey) R. T. Clausen].

Torreyochloa is distinguished as a separate genus following the discussion and references to the question of its delimitation given in Dore and McNeill (1980).

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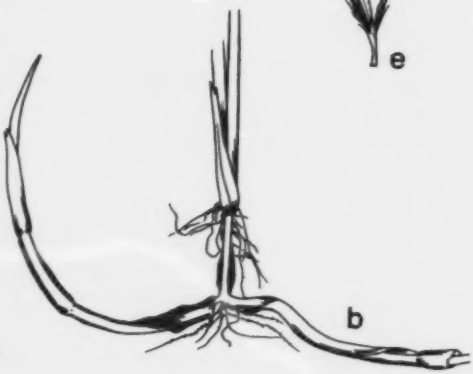
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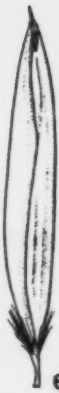
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Characters to distinguish *Glyceria, Puccinellia,* and *Torreyochloa*

Character	*Glyceria*	*Puccinellia*	*Torreyochloa*
Base of plant	With long rhizomes.	Densely tufted, without rhizomes, sometimes stoloniferous.	Stems decumbent, rooting at the nodes, without rhizomes or stolons.
Adaxial blade surface	Usually glabrous, occasionally scaberulous.	With trichomes, usually scabrous or scaberulous.	With trichomes, scabrous or pubescent.
Leaf sheath	Closed to near the summit, splitting easily, margins not overlapping.	Open to the base, margins overlapping.	Open, margins overlapping.
Ligule	Lacerate or entire.	Entire.	Lacerate.
Rachilla	Glabrous or with trichomes.	Glabrous.	With trichomes.
Upper glume	One-nerved.	Three-nerved.	Three-nerved.
Lemma	Prominently 7-nerved, glabrous, scabrous, or puberulent.	Obscurely 5-nerved, glabrous. Pubescent at the base, apically glabrous.	Prominently 5-nerved, scabrous.
Stamens	Three, rarely 2.	Three.	Three.
Ovary apex	Glabrous.	Glabrous.	With sparse, minute, trichomes.
Lodicules	Seemingly 1 or the pair fused, fleshy.	Two, free, membranous.	Two, free, membranous.
Chromosomes	Small or medium in sets of 10.	Large in sets of 7, long and narrow.	Large in sets of 7, long and wide.
Habitat	Aquatic or wetland.	Saline or alkaline.	Wetland.

10. *Vulpia* K. C. Gmelin

Fig. 12

Spring annuals, pale green, tufted, to 15 cm high. Nodes exposed, glabrous; upper culm internodes glabrous or pubescent, hollow. Sheaths open, pubescent or glabrous; margins overlapping, hyaline; ligule membranous, lacerate, less than 1 mm long, decurrent; auricles absent; collars distinct, divided, glabrous; blades rolled in bud and remaining inrolled, less than 0.5 mm wide, glabrous; margins with scabrous projections.

Inflorescence a spike or contracted spikelike panicle. Spikelets laterally compressed, disarticulating above the glumes and between the 3–many florets; rachilla pubescent opposite the adjacent floret, prolonged beyond the uppermost fertile floret. Glumes unequal, narrow, shorter than the adjacent lemma; lower glumes narrow, 1-nerved; upper glumes approximately twice as wide, 3-nerved. Lemmas rounded on the back with margins inrolled, inconspicuously 5-nerved, tapering to a delicate, straight awn 1.5–4 mm long. Paleas as long as the lemmas, green, keeled and puberulent on the outer surface at the 2 nerves. Lodicules 2, free, distally membranous, with or without toothed margins, without trichomes. Anthers 1, rarely 3. Ovary apex glabrous; styles free to the base; stigmas white. $x = 7$.

Vulpia octoflora (Walter) Rydb. [*Festuca octoflora* Walter].

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Fig. 12. *Vulpia octoflora*. (*a*) Large, whole plant; rapid-growing annual with a small root system and a few narrow, setaceous leaves on the culm; inflorescence a reduced spikelike panicle. Approximately 0.8×. (*b*) Small, whole plant; inflorescence reduced and not branching, a spike with only 2 spikelets. Approximately 0.8×. (*c*) Junction of the leaf sheath and the blade; sheath open with margins overlapping, membranous, and extending as unequal sheath auricles; ligule less than 1 mm, membranous, lacerate, with an erose–ciliate apex. Approximately 16×. (*d*) Spikelet with 7 florets; glumes subequal to unequal, shorter than the adjacent lemmas. Approximately 6×. (*e*) Lemma with 5 veins that converge toward the apex; apex unnotched, with a short, straight, scabrous awn; in this view lemma base is glabrous, but this character varies from specimen to specimen. (*f*) Lodicules 2, membranous and toothed. Approximately 50×.

Tribe Aveneae

11. *Agrostis* L.

Fig. 13

Perennials, low to moderately tall, with or without rhizomes or stolons. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths open, glabrous; margins overlapping; ligules membranous, entire, lacerate, or apically puberulent, 2–4 mm long; auricles absent; collars often indistinct; blades rolled in bud, flat or setaceous, glabrous; surfaces scabrous or pubescent; margins scabrous.

Inflorescence an open or contracted panicle. Spikelets small, slightly laterally compressed, disarticulating above the glumes, 1-flowered. Glumes equal or subequal, keeled, with scabrous teeth along the keel, otherwise glabrous, 1-nerved, usually exceeding the lemma in length. Lemmas usually with a hairy callus, sometimes only a few hairs, otherwise glabrous, membranous, rounded on the back, acute to obtuse at the apex, 5-nerved, usually without an awn, occasionally with a straight awn arising dorsally and included within the glumes. Paleas lacking or vestigial, to nearly as long as the lemmas, nerveless or 2-nerved, membranous, colorless, glabrous. Lodicules 2, free, distally membranous, usually not toothed. Anthers 3. Ovary apex glabrous; styles free to the base; stigmas white. $x = 7$.

Agrostis exarata Trin., *A. gigantea* Roth [*A. alba* auct. amer., non L.; *A. stolonifera* var. *major* (Gaudin) Farwell], *A. scabra* Willd., *A. stolonifera* L. [including *A. palustris* Hudson].

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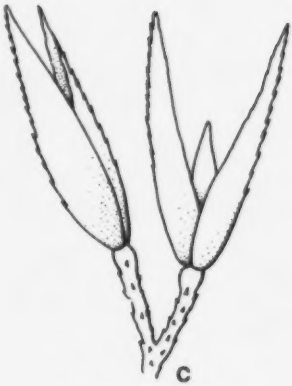
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Fig. 13. *Agrostis scabra*. (*a*) Whole plant, caespitose, including the remains of previous season's growth (3 culms without panicles drawn); leaves narrow, flat or setaceous, borne basally on the culms; inflorescence a large, loose, open panicle with widely spaced spikelets on capillary branches. Approximately 0.3×. (*b*) Junction of the leaf sheath and the blade; sheath scaberulous with margins overlapping, hyaline; ligule membranous, lacerate, with scaberulous projections on the adaxial surface; blade with numerous, scabrous projections on the uniform veins and the margins. Approximately 10×. (*c*) Inflorescence branch with 2 single-flowered spikelets borne on swollen receptacles at the end of scabrous capillary branches; glumes subequal, with a stiffly ciliate keel at the single nerve, elsewhere glabrous; lemma shorter than the glumes. Approximately 7.5×. (*d*) Lemma with a basal callus of short, stiff trichomes, elsewhere glabrous, 5 nerves; palea absent or very much reduced in this species. Approximately 15×.

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12. *Alopecurus* L.

Fig. 14

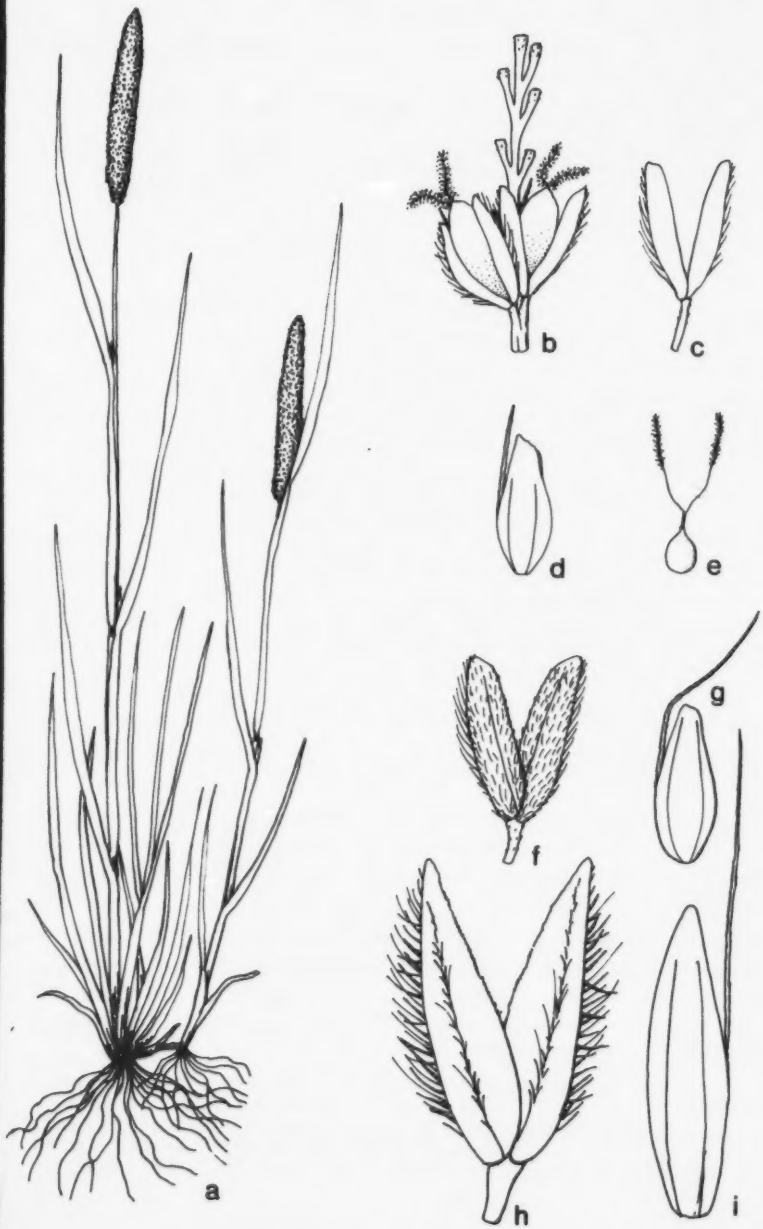
Perennials, to 1 m high. Culms decumbent, glabrous; nodes exposed; upper culm internodes hollow. Sheaths open, glabrous; margins overlapping, hyaline; ligules membranous, lacerate, erose–ciliolate, 2–5 mm long; auricles absent; collars variable; blades rolled in bud, flat, less than 0.5 cm wide, without hairs; surfaces with or without scabrous projections; margins scabrous.

Inflorescence a dense spikelike panicle. Spikelets strongly laterally compressed, disarticulating below the glumes, 1-flowered; rachilla not prolonged. Glumes equal, awnless, ciliate on the keels, 3-nerved. Lemmas about as long as the glumes, glabrous, 5-nerved, awned from below the middle with a single awn that is 0.2–2 cm long and straight or spirally twisted when dry. Paleas and lodicules absent. Anthers 3. Ovary apex glabrous; styles fused at least near to the base; stigmas colorless or white. $x = 7$.

Key to western rangeland species

1. Panicles thick, usually about 10 mm wide; spikelets 5–6 mm long; glumes acute; dry or moist meadow habitats ..... ***A. pratensis*** L.
1. Panicles slender, about 5 mm wide; spikelets less than 4 mm long; glumes obtuse; damp or standing water habitats.
   2. Awn geniculate, distinctly exserted beyond the glumes, 5–8 mm long ..... ***A. geniculatus*** L.
   2. Awn straight, scarcely if at all exceeding the glumes, 0.7–3 mm long ..... ***A. aequalis*** Sobol.

Fig. 14. *Alopecurus*. (*a*–*e*) *A. aequalis*. (*a*) Whole plant, caespitose, culms erect; culm nodes glabrous and usually exposed; leaves mostly cauline, their sheaths with closely overlapping margins; inflorescence a spikelike, contracted panicle. Approximately 0.5×. (*b*) Upper portion of the inflorescence partially dehisced; spikelets dehisce below the glumes, starting from the apex of the inflorescence and continuing toward the base, leaving a rachis and short branches, which give a frayed appearance to the top of the rachis. Approximately 9.5×. (*c*) Glumes subequal, strongly laterally compressed with long trichomes on the keels, but none on the glume margins; apex rounded, obtuse. Approximately 10×. (*d*) Lemma glabrous, with 5 nerves that do not converge at the broadly rounded apex, margins fused for approximately half the length. Approximately 10×. (*e*) Mature ovary; styles fused at the base just above the glabrous ovary, long, with relatively few stigmatic branches from the upper two-thirds of the style. Approximately 10×. (*f*, *g*) *A. geniculatus*. (*f*) Glumes equal, with 3 nerves that reach almost to the blunt apices, long ciliate hairs on the keels, and pubescent on the dorsal surface and margins. Approximately 10×. (*g*) Lemma 5-nerved, glabrous, with a twisted, geniculate awn that arises dorsally below the middle of the lemma, and is twice as long as the lemma. (*h*, *i*) *A. pratensis*. (*h*) Glumes with long cilia on the keels and less pronounced pubescence on the 2 lateral nerves and margins, glabrous between the nerves, tapering to an acute apex. Approximately 10×. (*i*) Lemma glabrous, tapering to a pointed apex with a short, straight awn arising dorsally toward the base. Approximately 15×.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13. *Apera* Adanson

Tufted annuals, less than 75 cm high. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths glabrous, open; margins overlapping, hyaline; ligules membranous, lacerate, 2.5–4.5 mm long; auricles absent; collars indistinct, divided; blades rolled in bud, flat or involute, less than 5 mm wide; adaxial surface pubescent, abaxial surface glabrous; margins scabrous.

Inflorescence an open or contracted panicle; rachis branches scabrous. Spikelets disarticulating above the glumes, 1-flowered; rachilla prolonged beyond the floret as a slender, glabrous bristle, sometimes with an apical sterile floret. Glumes subequal, rounded on the back, with scabrous projections near the apex and prominent nerves, the lower 1-nerved, the upper 3-nerved. Callus of lemma with short hairs. Lemmas stiff, rounded on the back, scabrous, with 5 indistinct nerves that converge, awned from just below the apex with a straight or curved awn to 1.5 cm long. Paleas slightly shorter than the lemmas, pleated inward between the 2 green nerves, scabrous at least at the apex. Lodicules 2, free, membranous, glabrous, untoothed. Anthers 3. Ovary apex glabrous; styles free to the base; stigmas white. $x = 7$.

A genus of three species, closely related to *Agrostis* and included in that genus in the first edition of Hitchcock's manual (1935). The stiff lemma, subterminal awn, and the well-developed, pleated palea are the distinguishing characters.

Apera interrupta (L.) Beauv. is native to the cooler parts of Eurasia. It has been recorded from roadsides and rangelands in southern British Columbia, and has been collected several times since 1940. It has recently been recorded in Ontario (McNeill 1981) and could be expected to spread in western rangelands.

Reference

McNeill, J. 1981. *Apera*, silky-bent or windgrass, an important weed genus recently discovered in Ontario, Canada. Can. J. Plant Sci. 61:479–485.

14. *Avena* L.

Fig. 15

Annuals 25–190 cm high, without rhizomes. Culms usually glabrous; nodes exposed; upper culm internodes hollow. Sheaths open, glabrous; margins overlapping, usually hyaline; ligules membranous, lacerate, usually with scabrous projections on the abaxial surface, 3–5 mm long; auricles absent; collars distinct, glabrous, yellowish, divided or undivided; blades rolled in bud, flat, to 2 cm wide, hairless; surfaces and margins with or without scabrous projections.

Inflorescence an open panicle with pendulous spikelets borne on long pedicels. Spikelets laterally compressed, readily disarticulating above the glumes and between the 2–3 florets (except in cultivated oats); rachilla hairy or glabrous and prolonged beyond the uppermost fertile floret. Glumes subequal, longer than the lower florets, rounded on the back, mucronate, glabrous, 7–11-nerved. Lemmas with or without a bearded callus, indurate, rounded on the back, with 7–9 nerves that converge toward the apex, with or without a stout awn that arises dorsally from approximately the middle of the lemma. Paleas almost as long as the lemmas, keeled, pubescent and colored at the 2 nerves; apex notched. Lodicules 2, free, distally membranous, without hairs, with or without a toothed margin. Anthers 3. Ovary apex hairy; styles rudimentary or almost absent, free to the base; stigmas white. $x = 7$.

Key to western rangeland species

1. Spikelets mostly 2-flowered; awn usually straight or absent; lemma and rachilla hairless ..... ***A. sativa*** L.
1. Spikelets mostly 3-flowered; awn twisted and geniculate; lemma and rachilla with long trichomes ..... ***A. fatua*** L.

As noted by Cronquist et al. (1977), *A. sativa*, the cultivated oats, probably originated from *A. fatua* through selection by man. The two are morphologically similar and distinctions between them often break down. Some taxonomists accept the combination *Avena fatua* var. *sativa* (L.) Hausskn.

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Fig. 15. *Avena*. (*a*–*c*) *A. fatua*. (*a*) Whole plant with relatively few fibrous roots; leaves flat, borne mainly on the culms; inflorescence an open panicle with spikelets borne on capillary branches. Approximately 0.3×. (*b*) Spikelet, with subequal, glabrous glumes that have many nerves converging toward an acute apex, usually 3 florets, the lower two with awns. Approximately 2.3×. (*c*) Lemma, with a basal callus of short trichomes and longer trichomes on the lower half, rounded on the back and scabrous in the upper half on the 7–9 nerves; apex notched; awn spirally twisted, geniculate, arising dorsally about the middle of the lemma. Approximately 2.5×. (*d*, *e*) *A. sativa*. (*d*) Spikelet, glumes similar to those of *A. fatua*, usually 2 florets, but only the lemma of the basal floret awned. Approximately 2×. (*e*) Lemma, callus glabrous or with a few basal trichomes; awn straight, arising dorsally about the middle of the lemma; 7–9 veins with small, scabrous projections, converging toward the acute, slightly notched apex. Approximately 3.4×.

15. *Beckmannia* Host

Fig. 16

Tufted annuals, to 1 m high. Culms glabrous; nodes sometimes exposed; upper culm internodes hollow. Sheaths open, glabrous; margins overlapping, hyaline; ligules membranous, entire or lacerate when old, to 10 mm long; auricles absent; collars indistinct, divided; blades rolled in bud, flat, to 1.2 cm wide, hairless; surfaces and margins with scabrous projections.

Inflorescence a simple or sparingly rebranched diffuse or compact panicle composed of a central rachis and short branches 1–2 cm long with 2 rows of almost sessile spikelets. Spikelets awnless, laterally compressed, disarticulating below the glumes, 1(–2) florets; rachilla not prolonged beyond the uppermost flower. Glumes equal, inflated, scaberulous on the keel, with 3 nerves that converge at a mucronate apex and lateral nerves arising from the central nerve. Lemmas narrow, keeled and minutely scaberulous on the back, with 5 nerves that converge toward the apex in a sharply curved tip that protrudes beyond the glumes. Paleas as long as the body of the lemmas, colorless, glabrous, slightly keeled at the 2 nerves. Lodicules 2, free, distally membranous, glabrous, sometimes with a toothed margin. Anthers 3. Ovary apex glabrous; styles free to the base; stigmas white. $x = 7$.

Beckmannia syzigachne (Steudel) Fern. American slough grass. Found in marshes and ditches in the Prairie Provinces and British Columbia. The genus has 2 species, the other, *B. erucaeformis* (L.) Host, is European and has not been introduced into Canada. The genus was classified in the Chlorideae by Hitchcock and Chase (1951), but was transferred to the Aveneae by Reeder (1953) after consideration of several fundamental characteristics.

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Fig. 16. *Beckmannia syzigachne*. (*a*) Whole plant. Approximately 0.33×. (*b*, *c*) Ligules, entire, membranous and tapering to an acuminate apex that may become lacerate with aging. Approximately 6×. (*b*) Ligule from an upper leaf. (*c*) Ligule from a lower leaf. (*d*) Inflorescence branches with spikelets subsessile and arranged in two rows; florets enclosed in the subequal and inflated, winged glumes; lemma tip sharply curved, protruding beyond the glumes. Approximately 4×. (*e*) Spikelet with glumes prised open to expose a single floret; glume margins membranous and transparent; glumes green between the white lateral veins and the keel, with transverse veins; lemma with 5 veins that converge toward apex. Approximately 12×. (*f*) Lodicules, glabrous, entire, membranous. Approximately 60×.

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16. *Calamagrostis* Adanson

Fig. 17

Perennials, usually 50–100 cm high, with or without rhizomes. Culms glabrous, erect, sometimes branching; nodes exposed; upper culm internodes hollow. Sheaths open to the base; margins overlapping, hyaline; ligules membranous, often abaxially puberulent or scabrous, 3 mm or more long, lacerate; auricles absent; collars variable; blades rolled at emergence, flat or involute at maturity; adaxial surface glabrous, scabrous, or pubescent, abaxial surface glabrous, scabrous, or scarcely pubescent; margins scabrous.

Inflorescence an open or contracted panicle. Spikelets pedicellate, disarticulating above the glumes, 1-flowered; rachilla prolonged, sometimes only as a hairy bristle. Glumes subequal, longer than the lemmas, acute, keeled or slightly laterally compressed, 1–3-nerved, awnless. Lemma callus prominently bearded; lemmas glabrous or slightly scabrous on rounded back, 5-nerved, with a single dorsal awn arising from near the middle or below. Paleas from half as long to as long as the lemmas, colorless, rounded or keeled at the 2 nerves. Lodicules 2, distally membranous, free, glabrous; margins usually entire, occasionally toothed. Anthers 3, yellow or purple. Ovary apex glabrous; styles free to the base; stigmas white. $x = 7$.

Calamagrostis canadensis (Michaux) Nutt., *C. montanensis* Scribner, *C. rubescens* Buckley, *C. stricta* (Timm) Koeler [including *C. inexpansa* A. Gray and *C. neglecta* (Ehrh.) P. Gaertner, B. Meyer & Scherb.].

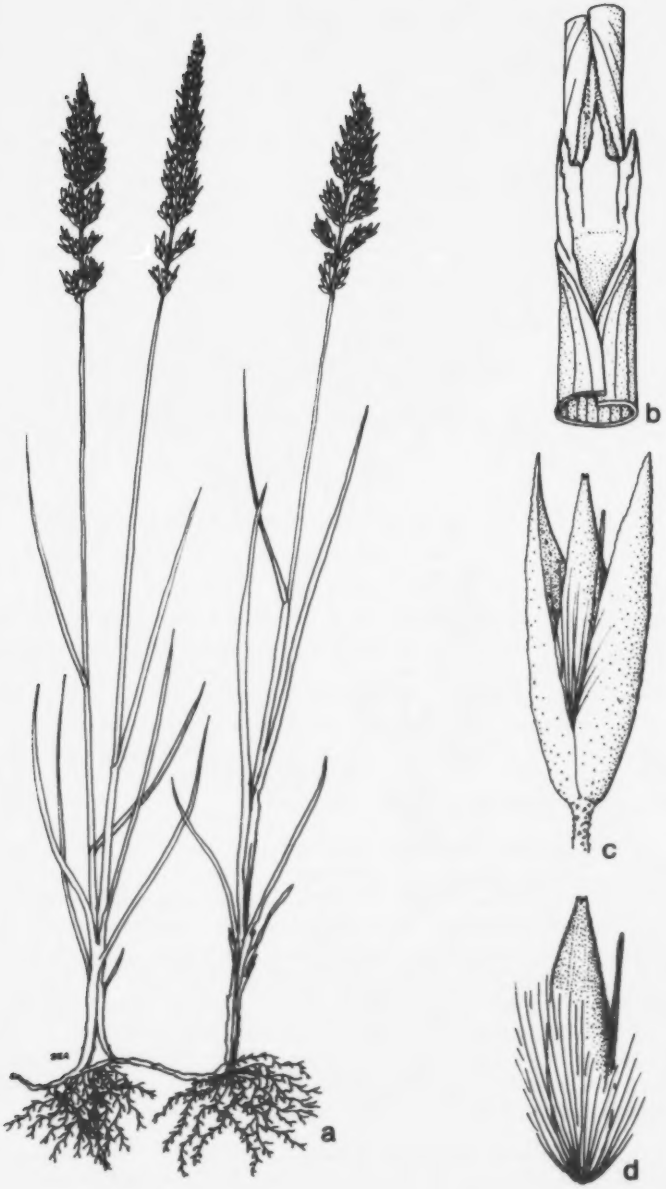
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Fig. 17. *Calamagrostis montanensis*. (*a*) Whole plant with long rhizomes at the base; leaves setaceous by rolling; inflorescence a compacted, spikelike panicle. Approximately 0.6×. (*b*) Junction of the leaf sheath and the blade; sheath glabrous, with overlapping membranous margins; ligule membranous, terminally fringed with fine hairs, lacerate; blade with prominent, uniformly thick veins that have scabrous projections. Approximately 7.5×. (*c*) Spikelet; glumes equal, longer than the lemma and the lemma awn, slightly keeled, scaberulous on the keel, elsewhere glabrous. Approximately 13×. (*d*) Floret; callus of long hairs extending about three-quarters of the length of lemma, elsewhere lemma short pubescent; awn arising dorsally below the middle of the lemma, but not reaching to the top. Approximately 13×.

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17. *Cinna* L.

Perennials, to 1.5 m high, without rhizomes. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths open, glabrous or scabrous; margins overlapping, membranous; ligules membranous, 3–8 mm long; sheath auricles 3–8 mm long; collars distinct, divided or undivided, glabrous, pale yellow; blades rolled in bud, flat, to 1.5 cm wide, hairless; upper surface and margins with scabrous projections, these present or absent on the lower surface.

Inflorescence an open panicle; rachis and rachis branches scabrous. Spikelets laterally compressed, disarticulating below the glumes; rachilla short and scabrous between the glumes and the single floret, prolonged

beyond the palea as a minute bristle. Glumes subequal, keeled, with stiff hairs on the keel, margins hyaline, the lower glume 1-nerved, the upper glume 1–3-nerved. Lemmas acute, keeled, scabrous, 3-nerved, with short, straight awn, 1–2 mm, that arises near the unnotched apex. Paleas 0.7–0.95 times the length of the lemma, colored, keeled, with stiff hairs on the keel area that is formed from 2 veins very close together. Lodicules 2, free, membranous, glabrous, with toothed margins. Anthers 1, yellow. Ovary apex glabrous; styles free to the base; stigmas white. $x = 7$.

Cinna latifolia (Trev.) Griseb. is found throughout boreal forests, in alder thickets, wet hollows, and forest openings in the western provinces. *Cinna arundinaceae* L. has not been recorded for the Prairie Provinces, but it does occur in Ontario and in Minnesota, and may be found in southeastern Manitoba.

18. *Deschampsia* Beauv.

Fig. 18

Tufted perennials, to 120 cm high. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths glabrous, open to the base; margins overlapping, hyaline; ligules membranous, entire or lacerate,

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Fig. 18. *Deschampsia*. (*a*–*d*) *D. caespitosa*. (*a*) Whole plant, caespitose, leaf bases from previous season's growth persistent; leaves folded or flat, more than 1 mm wide; inflorescence an open panicle with many lax branches. Approximately 0.5×. (*b*) Spikelet in bud, 2 florets; glumes shorter than spikelet, rounded on the back, membranous; lemmas with a 4-toothed apex; lemma awns approximately reaching the apex of the lemma; anthers that are almost as long as the lemma can be seen in silhouette through the membranous lemma wall. Approximately 7×. (*c*) Spikelet at time of pollination; glumes, lemma, and palea widely divergent; anthers that released pollen earlier have been shed from the florets and the short filaments have withered; gynoecium and stigmas exposed; lemma awns short; upper rachilla pubescent, extending beyond the uppermost fertile floret. Approximately 7×. (*d*) Lemma rounded on the back, with callus hairs less than one-third of the lemma length; lemma appearing to have no nerves other than the one associated with the awn, or sometimes with 4 faint nerves; lemma awn arising dorsally near the middle and extending to the regularly toothed apex. Approximately 10×. (*e*–*g*) *D. elongata*. (*e*) Lemma, with callus hairs extending two-thirds of the length of the lemma and 5 very faint nerves; awn arising dorsally about the middle of the lemma but extending well beyond the lemma apex; lemma apex with 4 teeth and a central apical notch. Approximately 10×. (*f*) Junction of the leaf sheath and the blade; ligule decurrent with the sheath margins and extending as sheath auricles; collar indistinct, divided; blade folded, glabrous. Approximately 3×. (*g*) Whole plant, densely caespitose; leaves setaceous, remaining folded as in the bud, less than 0.3 mm wide; inflorescence a compact, slender, spikelike panicle. Approximately 0.5×.

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5–10 mm long; auricles absent; collars variable; blades folded in bud, to 6 mm wide, flat or setaceous; adaxial surface glabrous, abaxial surface scabrous or glabrous; margins scabrous or scaberulous.

Inflorescence an open or contracted panicle; rachis branches slender, glabrous. Spikelets laterally compressed, disarticulating above the glumes and between the (1–)2(–3) florets; rachilla pubescent, prolonged beyond the uppermost fertile floret. Glumes equal, approximately the length of the adjacent lemma, keeled or rounded on the back, glabrous or scabrous on the keel, 1–3-nerved, awnless. Lemma callus bearded; lemmas rounded on the back and at the apex, the 5 nerves often obscure, not converging; awned from or below the middle with a single awn that is up to 1 cm long and straight or curved when dry. Paleas almost the length of the lemmas, colorless, keeled at the 2 nerves. Lodicules 2, free, distally membranous, entire or toothed, glabrous. Anthers 3. Ovary apex glabrous; styles free to the base; stigmas white. $x = 7$.

Deschampsia caespitosa (L.) Beauv., *D. elongata* (Hooker) Munro ex Benth.

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19. *Helictotrichon* Besser ex Schultes & Schultes fil. (*Avenula* (Dumort.) Dumort.)

Fig. 19

Tufted perennials (ours), less than 0.5 m high. Culms glabrous; nodes exposed or not; upper culm internodes hollow. Sheaths glabrous except at the prominent midvein that is sometimes scabrous, open to the base; margins usually not overlapping, sometimes hyaline; ligules membranous, entire, 4–8 mm long, sometimes with an acuminate tip; auricles absent; collars indistinct, divided, glabrous; blades folded in bud, flat, or remaining folded, less than 5 mm wide, with 2 rows of bulliform cells that result in a lighter-colored line on either side of the

midvein (a similar condition in *Poa*), other veins usually obscure; lamina surfaces glabrous; margins scabrous; abaxial midvein scabrous toward the blade apex.

Inflorescence a contracted panicle, sometimes spikelike. Spikelets laterally compressed, disarticulating above the glumes and between the 1–6 florets. Glumes subequal, as long as or slightly longer than the adjacent lemma, acute, tapering to a long, narrow apex, 3-nerved, scaberulous on the keel, elsewhere glabrous. Callus bearded with short, stiff hairs. Lemmas rounded on the back, glabrous to scaberulous, 5–7-nerved, awned dorsally from about the middle of the lemma; apex with an apical notch. Paleas 0.7–0.95 times the length of the lemmas, colorless, strongly keeled, and stiffly puberulent on the outer surface at the 2 nerves. Lodicules 2, free, distally membranous, glabrous, toothed at the margins, up to 3 mm long. Anthers 3, often purple, sometimes yellow. Ovary apex pubescent; styles free to the base; stigmas white. $x = 7$.

Helictotrichon hookeri (Scribner) Henrard.

The genus *Helictotrichon* has been subdivided and a separate genus, *Avenula*, recognized by Holub (*in* Tutin et al. 1980) working in Europe. If his treatment is adopted, Canadian species would be placed in *Avenula*. Holub separated the genera using the following relatively minor characters.

Characters used to distinguish *Avenula* from *Helictotrichon*

Character	*Avenula*	*Helictotrichon*
Leaf venation	Two distinct lines of bulliform cells along the blade midvein.	Distinctly ribbed above, without two rows of bulliform cells, or with several rows of small bulliform cells between the ribs.
Roots	Without sclerenchyma around the endodermis.	With a sclerenchyma ring around the endodermis.
Ligule of cauline leaves	Acute.	Usually truncate–dendate.
Spikelets	Erect, with 2–7 fertile florets.	Erect or spreading, with 2–4 fertile florets and 1–(2) sterile florets.
Lower glume	One (–3)-veined.	One-veined.
Upper glume	Three(–5)-veined.	Three-veined.
Awn	Twisted and usually compressed in the lower part.	Geniculate, more or less teret in the lower part.

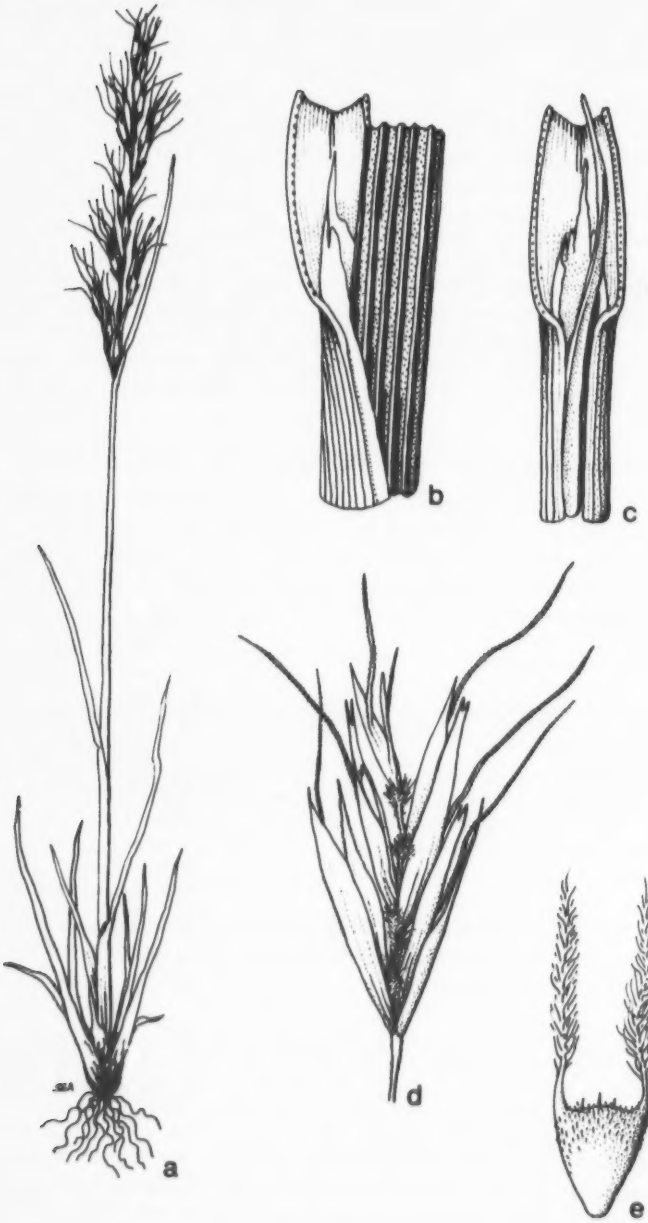
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Fig. 19. *Helictotrichon hookeri*. (*a*) Whole plant, tufted with mostly basal leaves; sheaths open; margins not overlapping; inflorescence a contracted, spikelike panicle. Approximately 0.5×. (*b*) Junction of the leaf sheath and the blade with culm at right; sheath open to the base, keeled at central midvein; ligule lacerate, 4 mm high at sides, rising to an acuminate point 7 mm high; blade glabrous, with prominent midvein. Approximately 5×. (*c*) Junction of the leaf sheath and the blade; blade folded and surrounding a developing leaf that is folded in bud. Approximately 5×. (*d*) Spikelet with 5 fertile florets, a remnant floret, and a rachilla that is prolonged beyond this floret; rachilla with prominent hairs that are longest at the base of each floret and merge with a lemma callus; lemma awns single, spirally twisted, arising dorsally about the middle of each apically notched lemma; palea transparent, membranous, almost as long as lemma and lying against the inner surface of the lemma. Approximately 3×. (*e*) Gynoecium; ovary apex with sparse, ciliate trichomes; styles arising on either side of the broad apex. Approximately 50×.

The name *Avenochloa*, used by Douglas et al. (1981) following Kartesz and Kartesz (1977), is illegitimate because of the earlier name *Avenula* (Holub 1976).

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Holub, J. 1976. A newly adopted restriction of illegitimacy in generic names and its consequence for *Avenochloa* Holub 1962. Folia Geobot. Phytotax. Praha 11:281–300.

20. *Hierochloë* R. Br.

Perennials, with rhizomes, to 75 cm high; herbage fragrant from the presence of coumarin. Culms glabrous; nodes rarely exposed; upper culm internodes hollow. Sheaths glabrous, open; margins overlapping; ligules membranous, usually entire, erose–ciliolate at the apex, to 4 mm long, decurrent with the sheath margins; auricles absent; collars distinct, divided, glabrous, pale yellow; blades rolled in bud, flat, to 0.5 mm wide; surfaces usually glabrous, rarely puberulent; margins scaberulous.

Inflorescence a more or less open panicle; rachis branches glabrous. Spikelets pedicellate, awnless, disarticulating above the glumes but not between the 3 florets that fall as a unit; terminal floret hermaphroditic, the others staminate; rachilla glabrous, not prolonged. Glumes subequal, as long as the florets or only slightly shorter, broadest in the middle, tapering to an acute apex, papery and shiny, glabrous, 1–3-nerved. Lemmas of the staminate florets about as long as the glumes, broadly elliptic, pubescent along the margins and the slight keel,

5-nerved. Paleas of the staminate flowers colorless, keeled and pubescent at the 2 nerves, enclosing 3 stamens. Lemmas of the perfect flowers approximately three-quarters the size of those of the staminate flowers, almost glabrous at the base, tufted pubescent at the center and apex, 3-nerved. Paleas of the perfect flowers laterally compressed, with 1–3 nerves at the center, enclosing 2 stamens. Lodicules 2, free, membranous, glabrous, with entire or toothed margins. Ovary apex glabrous; styles 2, fused at the base; stigmas white. $x = 7$.

Hierochloë odorata (L.) Beauv.

Reference

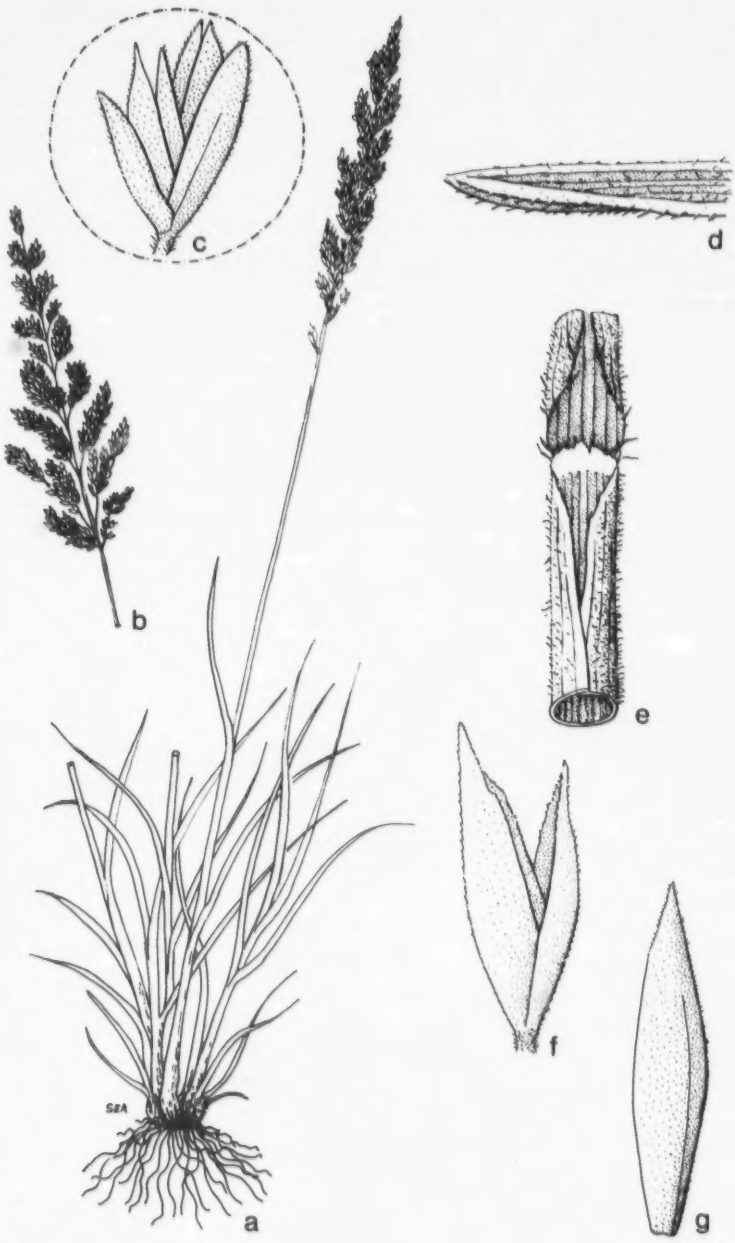
Weimarch, G. 1971. Variation and taxonomy of *Hierochloë* in the northern hemisphere. Bot. Nat. 124:129–175.

21. *Koeleria* Pers.

Fig. 20

Tufted perennials, usually less than 50 cm high. Culms glabrous or pubescent; nodes rarely exposed; upper culm internodes hollow. Sheaths open to the base; margins not overlapping, hyaline; ligules membranous, lacerate, to 1 mm long; auricles absent; collars indistinct, variable; blades folded at the midvein in bud, margins inrolled, remaining folded or becoming flat, less than 3 mm wide, usually pubescent on the outer surfaces; blade tip boat-shaped, with inrolled margins.

Fig. 20. *Koeleria macrantha*. (*a*) Whole plant, caespitose; leaves flat, basal and cauline; inflorescence a compact, spikelike panicle. Approximately 0.3×. (*b*) Panicle, more open and lax. Approximately 0.3×. (*c*) Spikelet with 2 florets, all organs tapering to more or less acute apices. Approximately 8×. (*d*) Leaf blade folded; apex boat-shaped, margins inrolled, surfaces pubescent. Approximately 10×. (*e*) Junction of the leaf sheath and the blade; sheath pubescent, open, with overlapping margins; ligule membranous, lacerate, to 1 mm long; auricle position with a few hairs; blade with several prominent veins. Approximately 10×. (*f*) Glumes subequal, slightly keeled, puberulent on the keel, elsewhere glabrous, tapering to an acute apex. Approximately 12×. (*g*) Lemma slightly keeled, puberulent on the keel, elsewhere glabrous, tapering to an acute apex. Approximately 12×.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Inflorescence paniculate, often contracted and spikelike. Spikelets awnless, laterally compressed, disarticulating above the glumes and between the (1−)2(−4) florets; rachilla pubescent, prolonged beyond the uppermost fertile floret. Glumes subequal, acute, pubescent or puberulent on the keel, elsewhere glabrous or pubescent, the lower glume 1-nerved, the upper glume broad, almost as long as the spikelet, often asymmetric, 1−3-nerved. Lemmas keeled or only slightly so, pubescent toward the base and toward the acute apex. Paleas almost as long as the lemmas, colorless, keeled and pubescent at the 2 nerves. Lodicules 2, free, distally membranous, glabrous, with toothed margins. Anthers 3. Ovary apex glabrous; styles free to the base; stigmas white. Caryopsis with liquid endosperm. $x = 7$.

Koeleria macrantha (Ledeb.) Schultes [*K. cristata* auct., *K. nitida* Nutt.].

Cronquist et al. (1977) discussed nomenclatural problems with this species. Because they were not sure that European and North American populations are conspecific, they choose to use the oldest North American name, *K. nitida* Nutt. Dore and McNeill (1980) treated Old World and New World populations as conspecific and concluded that the name *K. macrantha* has priority. Looman (1978) discussed this species in the Prairie Provinces under the name *K. gracilis* Pers. and separated two varieties on differences in the vestiture of the lower leaves and sheaths.

Characters to distinguish *Koeleria, Sphenopholis,* and *Trisetum*

Character	*Koeleria*	*Sphenopholis*	*Trisetum*
Leaf blade	Nerves prominent.	Nerves uniform, not prominent.	Nerves prominent.
Blade apex	Boat-shaped.	Pointed.	Boat-shaped.
Lamina in bud	Folded at midvein, margins inrolled.	Lamina rolled in bud.	Folded at midvein, margins inrolled.
Spikelet disarticulation	Above the glumes.	Below the glumes.	Above the glumes.
Glumes	Subequal to unequal, acute, often the upper glume asymmetric.	Unequal, rounded at the apex, the lower glume lanceolate, 1-nerved, the upper broadly ovate to oblanceolate, 3(−5)-nerved.	Subequal to unequal, acute.

Characters to distinguish *Koeleria, Sphenopholis,* and *Trisetum* (concluded)

Character	*Koeleria*	*Sphenopholis*	*Trisetum*
Lemma callus	Not bearded.	Not bearded.	Bearded callus (*T. spicatum, T. cernuum*).
Lemma apex	Acute.	Rounded.	Acute.
Lemma vestiture	Pubescent to puberulent, more trichomes toward the base and at the midvein.	Puberulent or almost glabrous.	Scaberulous.
Lemma nerves	Three–5 nerves reaching almost the length of the lemma, lateral nerves obscure.	Three nerves reaching the length of the lemma.	Three–5 nerves.
Awn	Awnless.	Awnless.	Awned (2 species) or awnless.

22. *Phalaris* L.

Fig. 21

Annuals or perennials, 30–200 cm high, with or without rhizomes. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths glabrous, open; margins overlapping, hyaline; ligules membranous, more than 3 mm long, entire or lacerate, sometimes abaxially scabrous, decurrent with sheath margins; collars glabrous, distinct or indistinct, yellowish; blades rolled in bud, flattened, 0.3–1.5 cm wide, surfaces scabrous or glabrous; margins scabrous.

Inflorescence a contracted panicle. Spikelets awnless, laterally compressed, disarticulating above the glumes, with 1 perfect terminal floret, and below, 1–2 scales interpreted as reduced flowers. Glumes equal or subequal, laterally flattened, and dorsally keeled, with or without a membranous wing, hairy, scabrous or glabrous, distinctly 3–5-nerved. Lemmas laterally compressed and elliptic but without a true keel, veins converging toward an acute apex, 5-nerved, pubescent or glabrous. Paleas strongly compressed, the 2 nerves sometimes very close together near the center. Lodicules free, membranous, glabrous, with or without marginal teeth. Anthers 3. Ovary apex glabrous; styles free to the base; stigmas white. $x = 6, 7$.

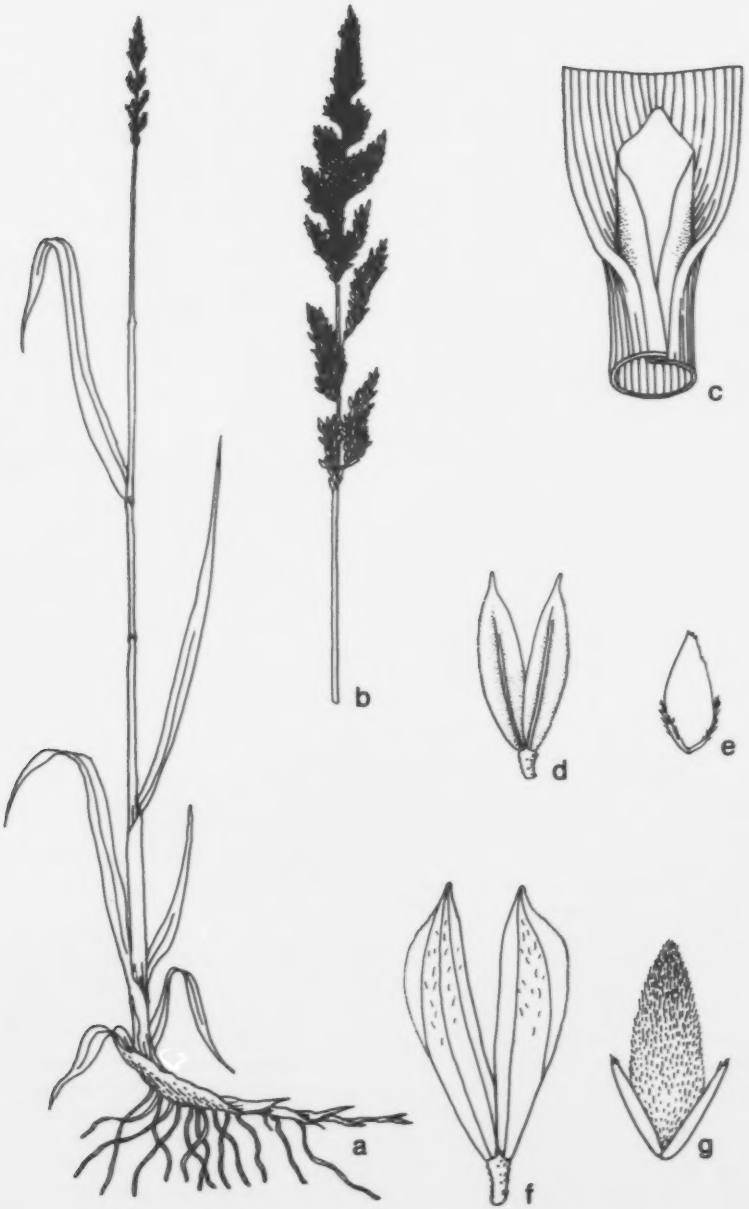
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Fig. 21. *Phalaris*. (*a*–*e*) *P. arundinacea*. (*a*) Whole plant, base with long scaly rhizomes, and the remains of previous season's growth; current leaves flat, borne mainly on the culms. Approximately 0.2×. (*b*) Inflorescence a contracted panicle. Approximately 0.7×. (*c*) Junction of the leaf sheath and the blade; ligule membranous, entire, with scabrous projections on the lower half of abaxial surface, decurrent; sheath margins membranous, overlapping. Approximately 10×. (*d*) Glumes strongly keeled, more scaberulous on the keels and the 2 lateral nerves but without hairs; margins slightly winged; apex acute. Approximately 6×. (*e*) Spikelet with glumes removed; 2 lower sterile florets pubescent; fertile lemma strongly laterally compressed without a keel, tapering to an acute apex, after fertilization nearly covering the palea that is almost as long. Approximately 6×. (*f*, *g*) *P. canariensis*. (*f*) Glumes subequal, strongly keeled with marginal and keel wings; abaxial surface with scattered long trichomes, inner surface glabrous; lower glume 3-nerved; upper glume 5-nerved; nerves converging at the acute apex. Approximately 6×. (*g*) Spikelet with glumes removed; 2 lower sterile florets longer but less pubescent than those in *P. arundinaceae*; lemma and palea of fertile floret similar, but larger and more conspicuously covered with trichomes. Approximately 6×.

Key to western rangeland species

1. Plants perennial, with rhizomes; panicle elongate; glumes not broadly winged ..... ***P. arundinacea*** L.
1. Plants annual, without rhizomes; panicle ovoid; glumes broadly winged on keel ..... ***P. canariensis*** L.

Reference

Anderson, D. E. 1961. Taxonomy and distribution of the genus *Phalaris*. Iowa St. Coll. J. Sci. 36:1–96.

23. *Phleum* L.

Fig. 22

Perennials, to 1 m high, tufted, without rhizomes. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths glabrous, open; margins overlapping, hyaline; ligules membranous, lacerate, 2–5 mm long, sometimes with sheath auricles; collars variable; blades rolled in bud, flat, 4–7 mm wide, hairless; surfaces scabrous to glabrous; margins scabrous.

Inflorescence a tightly contracted spikelike panicle, 1–11 cm long. Spikelets 1-flowered, strongly laterally compressed, disarticulating above the glumes, and usually below the glumes later on; rachilla absent. Glumes subequal, each stiffly ciliate on the strong keel, winged on the margins, acuminate or with a short awn at the apex, 1–3-nerved. Callus not bearded. Lemmas shorter than the glumes, blunt, rounded on the

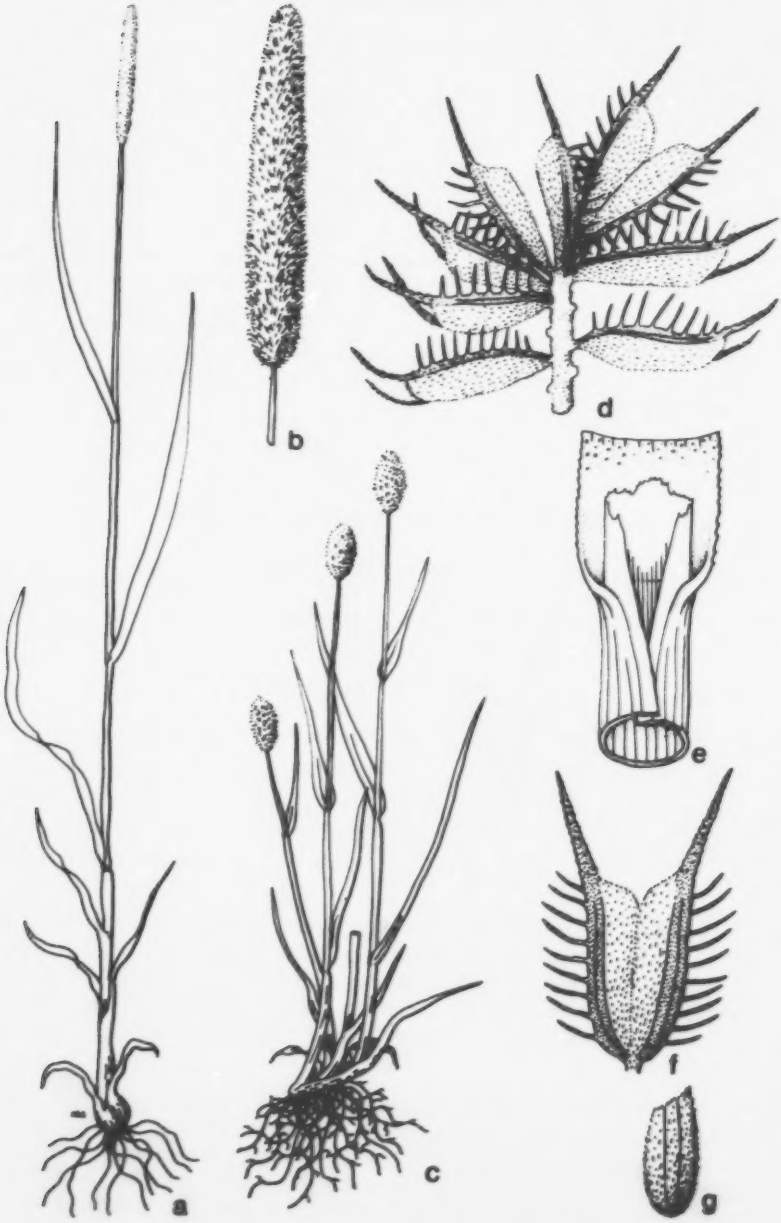
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Fig. 22. *Phleum*. (*a*, *b*) *P. pratense*. (*a*) Whole plant, erect, tufted; base of culm bulbous; leaves flat, mostly cauline. Approximately 0.3×. (*b*) Inflorescence a spikelike panicle many times longer than wide, disarticulating much later in the growing season than *Alopecurus*. Approximately 3×. (*c*) *P. alpinum*. Whole plant; base not bulbous; stems decumbent; inflorescence only 2–3 times longer than wide. Approximately 0.4×. (*d*–*g*) *P. pratense*. (*d*) Inflorescence rachis; spikelets have been removed from the rachis and 4 short, glabrous pedicels indicate where they were attached, rachis scabrous; the 5 lower spikelets are orientated so that only 1 glume keel per spikelet is seen. Approximately 4×. (*e*) Junction of the leaf sheath and the blade; sheath glabrous, with margins membranous, overlapping; sheath auricles often present; ligule 3 mm long, membranous, lacerate; blade margins scabrous; adaxial surface scaberulous. Approximately 5×. (*f*) Glumes strongly keeled, with stiff, pectinate cilia on the keel, green or yellow here and at the mucronate apex, elsewhere membranous, colorless, pubescent. Approximately 5×. (*g*) Lemma apex blunt, the 5 nerves almost parallel, not converging at the apex; outer surface pubescent. Approximately 10×. Glumes and lemmas in *P. alpinum* similar.

back or almost keeled, pubescent at least on the veins, the 5 veins not converging; midvein sometimes extended as a mucronate tip or short awn. Paleas slightly shorter than the lemmas, laterally compressed, membranous, colorless, 2-nerved. Lodicules 2, free, distally membranous, toothed or untoothed. Anthers 3, purple or yellow. Ovary apex glabrous; styles free to the base; stigmas white. $x = 7$.

Key to western rangeland species

1. Culms usually more than 50 cm high, erect, with a swollen, bulblike base; panicles several times longer than wide (4–16 cm long, 5.0–7.5(10) mm wide) ..... ***P. pratense*** L.
1. Culms usually less than 50 cm high, base non-bulblike, often decumbent; panicles only 2–3 times longer than wide (1–5 cm long, 8–12 mm wide) ..... ***P. alpinum*** L.

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Bowden, W. M. 1960. An experimental taxonomist examines the classification of grasses. Rev. Can. Biol. 19:279–292.

Nordenskiold, H. 1945. Cyto-genetic studies in the genus *Phleum*. Acta Agric. Suecana 1:1–138.

24. *Polypogon* Desf.

Fig. 23

Tufted annuals, occasionally to 1 m high, usually less. Culms erect or decumbent, glabrous; nodes exposed; upper culm internodes hollow. Sheaths glabrous, open; margins overlapping, hyaline; ligules membranous, entire, to 6 mm long; auricles absent; collars indistinct, divided,

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Fig. 23. *Polypogon monspeliensis*. (*a*) Whole plant, tufted, annual; leaf blades flat; inflorescence a dense, compact, spikelike panicle. Approximately 0.4×. (*b*) Inflorescence; disarticulation of the ripe fruit beginning at the apex and occurring below the glumes, leaving the pubescent rachis branches visible. Approximately 1.5×. (*c*) Single spikelet containing 1 perfect floret; glumes equal, heavily pubescent, each with a single awn 2–3 times the length of the body of the glume. Approximately 25×. (*d*) Lemma hyaline, rounded on the back, glabrous; midvein faint, sometimes extending into an awn of 1–2 mm arising from an apical notch. Approximately 30×. (*e*) Palea, almost as long as lemma, hyaline, membranous, glabrous, with a relatively deep apical notch and 2 nerves. Approximately 30×.

yellow green; blades rolled in bud, flat, 1–5 mm wide; margins and surfaces with scabrous projections.

Inflorescence a dense, spikelike panicle, 1–6.5 cm long, softly bristled with long, glume awns. Spikelets 1-flowered, disarticulating below the glumes and falling entire, strongly laterally compressed; rachilla absent. Glumes almost equal, rounded on the back, pubescent or scabrous, 1-nerved, with a straight awn several times the length of the glume arising from a slightly notched apex. Lemmas much shorter than the glumes, rounded on the back, glabrous, the 1–5 faint nerves not converging, with or without a short, delicate awn from a broad, toothed apex. Paleas almost as long as the lemmas, colorless, glabrous, rounded on the back, 2-nerved. Lodicules 2, membranous, glabrous, untoothed. Anthers 3, yellow. Ovary apex glabrous; styles free to the base; stigmas white. $x = 7$.

Polypogon monspeliensis (L.) Desf. An uncommon weed introduced from Europe. It is frequently used in dried flower arrangements.

25. *Sphenopholis* Scribner

Fig. 24

Tufted perennials, usually less than 1 m high. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths glabrous or scabrous, open to the base; margins overlapping, hyaline; ligules membranous, lacerate, 2–4 mm long; auricles absent; collars variable, often oblique; blades rolled in bud, 0.5–1.0 cm wide, flat; margins and surfaces with scabrous projections.

Inflorescence a contracted, spikelike panicle. Spikelets laterally compressed, disarticulating below the glumes, awnless, the 1–3 florets falling as a unit; rachilla pubescent, prolonged beyond the uppermost fertile floret. Glumes similar in length, unequal in width, the lower 1-nerved, narrow, strongly keeled with scabrous projections on the keel, the upper 3-nerved, broader, keeled or only slightly so, fewer scabrous

Fig. 24. *Sphenopholis*. (*a*–*e*) *S. obtusata*. (*a*) Whole plant, caespitose; leaves flat, basal and cauline; inflorescence a compact, spikelike panicle. Approximately 0.3×. (*b*) Panicle, more open and lax. Approximately 0.3×. (*c*) Spikelet with 2 florets, all organs more or less apically rounded; rachis pubescent; glumes pubescent on the keels, approximately the same length but unequal in width. Approximately 5×. (*d*) Junction of the leaf sheath and the blade; sheath open with margins overlapping, with fewer scabrous projections than the blade; ligule membranous, lacerate; blade flat; adaxial surface scabrous; veins uniformly thick. Approximately 10×. (*e*) Glumes stiff, puberulent on the keels, rounded at apex; *right*: lower glume narrow, 1-nerved at the keel; *left*: upper glume, broadly ovate, 3-nerved. Approximately 10×. (*f*) Lemma slightly keeled and pubescent on the keel, 3-nerved, tapering to a rounded apex. (*g*) *S. obtusata* var. *major*. Glumes; *right*: lower glume narrow; *left*: upper glume about half the width of the equivalent glume of *S. obtusata* and not winged on the margin. Approximately 10×.

projections present. Lemmas rounded on the back, the 3–5 nerves converging toward the apex, lateral nerves often indistinct, glabrous or pubescent. Paleas as long as the lemmas or slightly shorter, colorless, strongly keeled and pubescent at the 2 nerves. Lodicules 2, free, distally membranous, toothed. Anthers 3. Ovary apex glabrous; styles free to the base; stigmas white. Caryopsis with liquid endosperm. $x = 7$.

Sphenopholis [including *S. intermedia* Rydb.] *obtusata* (Michaux) Scribner.

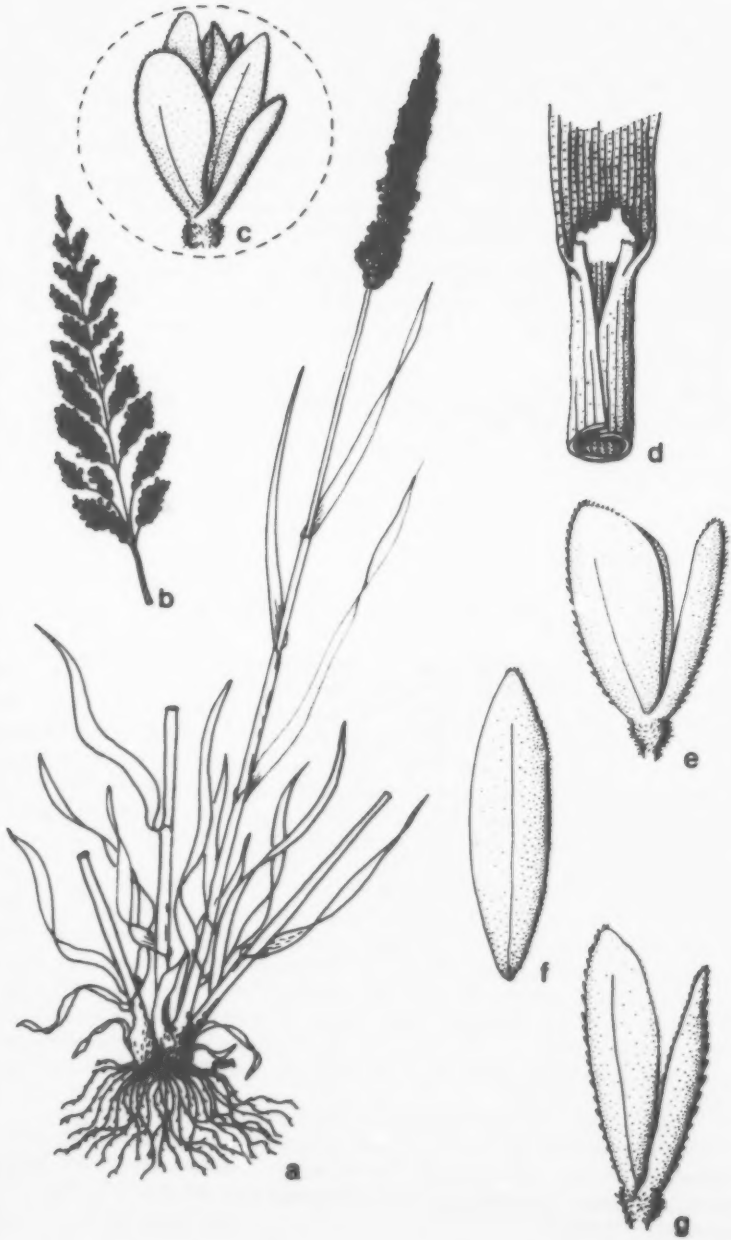
Reference

Erdman, K. S. 1965. Taxonomy of the genus *Sphenopholis*. Iowa St. Coll. J. Sci. 39:259–336.

26. *Trisetum* Pers.

Tufted perennials, to 1.2 m high, usually less. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths open to the base; margins overlapping; ligules membranous, usually lacerate, erose, to 5 mm long; auricles absent; collars variable; blades rolled in bud, flat, less than 1 cm wide; surfaces and margins variable.

Inflorescence an open or contracted panicle. Spikelets laterally compressed, disarticulating above the glumes and between the 2(–4) florets; rachilla often villous, prolonged beyond the uppermost fertile floret. Glumes unequal, or subequal, acute, with a slight keel, scaberulous on the keel, lateral nerves less than half the length of the glume, the lower glume 1–3-nerved, the upper glume 3-nerved.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Lemma callus usually bearded. Lemmas usually shorter than the upper glumes, acute, rounded on the back or with a slight keel and a well-developed apical notch, awned dorsally from the upper half of the lemma; awn single, short, and straight with the membranous tip sometimes divided into 2 slender soft teeth (awn absent or rudimentary in *T. wolfii*). Paleas almost as long as the lemmas, colorless, keeled and pubescent on the outer surface at the 2 nerves. Lodicules 2, free, distally membranous, toothed or lobed on the margins. Anthers 3. Ovary apex glabrous or pubescent; styles free to the base; stigmas white. $x = 7$.

Trisetum cernuum Trin. (including *T. canescens* Buckley), *T. spicatum* (L.) Richter, *T. wolfii* Vasey.

References

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Father Louis-Marie, O. C. 1928. The genus *Trisetum* in America. Rhodora 30:209–228, 231–245.

Tribe Triticeae

27. ×*Agroelymus* Camus ex A. Camus

The "generic name" used for hybrids between species of *Agropyron* and *Elymus*.

Perennials, to 1 m high, with rhizomes. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths open; margins overlapping, hyaline; ligules membranous, lacerate, less than 1 mm long; auricles present, clawlike; collars divided, often indistinct; blades rolled in bud, flat; surfaces and margins scabrous.

Inflorescence a spike with 1–2 spikelets at each node, these laterally compressed, disarticulating above the glumes and between the 1–4 florets. Glumes subequal or unequal, 1–3-nerved, awned. Lemmas rounded and pubescent on the back with a single, straight awn less than 2 cm long. Paleas almost as long as the lemmas, green, keeled and pubescent at the 2 nerves. Lodicules 2, free, distally membranous, with a toothed margin, with or without stiff trichomes. Anthers 3, abortive. Ovary apex pubescent; styles free to the base; stigmas white or golden. $x = 7$.

×*Agroelymus hirtiflorus* (A. S. Hitchc.) Bowden: *Agropyron trachycaulum* (Link) Malte ex H. F. Lewis × *Elymus innovatus* Beal; ×*Agroelymus turneri* Lepage: *Agropyron dasystachyum* (Hooker) Scribner × *Elymus innovatus* Beal.

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Nielsen, E. L.; Nath, J. 1961. Somatic instability in derivatives from *Agroelymus turneri* resembling *Agropyron repens*. Am. J. Bot. 48:345–349.

28. ×*Agrohordeum* Camus ex A. Camus

Fig. 26

The "generic name" for hybrids between *Agropyron* and *Hordeum*. These combine the characters of the two genera, often producing paired spikelets, an intermediate condition between the solitary spikelets of *Agropyron* and the usual arrangement in threes in *Hordeum*.

Tufted perennials, to 1 m high. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths open; margins overlapping; hyaline; ligules membranous, entire or lacerate, to 1 mm long, minutely erose; auricles poorly developed, clawlike when present; collars indistinct, divided; blades rolled in bud, becoming flat; surfaces glabrous or scaberulous; margins scabrous.

Inflorescence a spike; rachis flattened, the margins stiff, ciliate, often with 2 spikelets per node, sometimes with a small, involucral flap. Spikelets laterally compressed with 1–2 florets; rachilla puberulent. Glumes subequal, setaceous, 2–4-nerved, tapering to an awn. Lemmas rounded on the back, scaberulous, particularly at the base of the single, straight awn, 5-nerved. Paleas almost as long as the lemmas, green, keeled with short, stiff trichomes at the 2 nerves. Lodicules 2, free, distally membranous, pubescent with toothed margins. Anthers 3, usually poorly developed. Ovary apex pubescent; styles free to the base; stigmas white. $x = 7$.

×*Agrohordeum macounii* (Vasey) Lepage [*Elymus macounii* Vasey]: *Agropyron trachycaulum* × *Hordeum jubatum*. The plants are sterile but appear to arise at sites where both parents are present (Dore and McNeill 1980). This species is the most commonly found intergeneric hybrid of the Triticeae.

References

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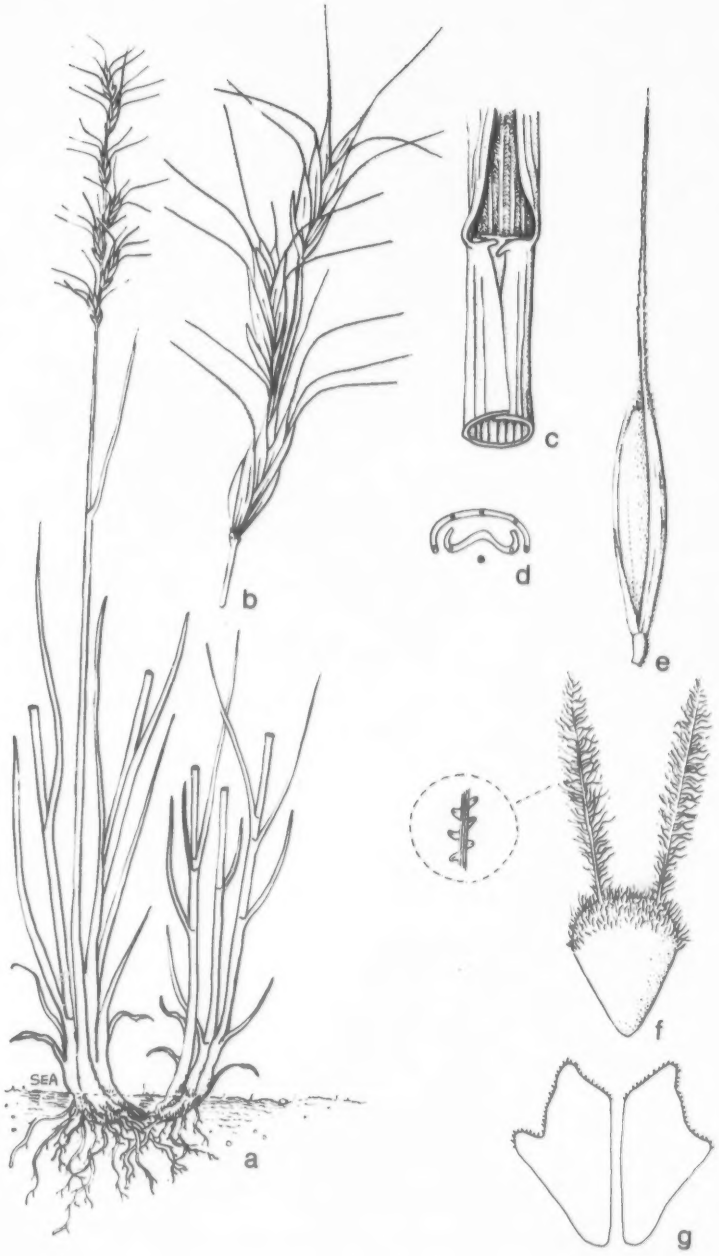
29. *Agropyron* Gaertner

Fig. 25

Rhizomatous or tufted perennials, to 1 m high, usually less. Culms glabrous; upper culm internodes hollow. Sheaths open; margins overlapping; ligules membranous, erose, entire or lacerate, less than 2 mm long; auricles clawlike, sometimes rudimentary; collars variable; blades rolled or involute in bud, setaceous or flat at maturity, usually less than 1 cm wide; surfaces variable; margins scabrous.

Inflorescence a bilateral spike of alternate, single spikelets, sometimes with a rudimentary involucral flap or fringe of hairs at the base on the flattened and hollowed rachis. Spikelets laterally compressed, the plane of compression parallel to the rachis, disarticulating above the glumes and between the 2–7 florets; rachilla pubescent or with scabrous projections, prolonged beyond the uppermost fertile floret. Glumes acute, usually subequal, with or without a keel, sometimes awned or tapering to a mucronate tip. Lemmas acute, indurate, rounded on the back, with 5–7 nerves converging toward the apex, with or without a single, straight or curved awn that arises from the apex, 1 cm long or less. Paleas almost as long as the lemmas. Lodicules 2, free, apically membranous, usually pubescent and with a toothed or lobed margin.

Fig. 25. *Agropyron spicatum*. (*a*) Whole plant, based tufted; leaves flat, basal and cauline; inflorescence a simple spike. Approximately 0.25×. (*b*) Group of 3 spikelets, alternating, appressed to the rachis; glumes approximately equal, 5–6 florets per spikelet; lemma with a long awn that curves away from the rachis at maturity, sometimes lacking an awn. Approximately 2×. (*c*) Junction of the leaf sheath and the blade; sheath glabrous, with margins overlapping; auricles claw-shaped; ligule short; adaxial leaf surface pubescent, abaxial surface glabrous. Approximately 5×. (*d*) Diagrammatic cross section through a floret showing the overlapping of the lemma and palea; *above:* lemma convexly rounded on the back, 5-nerved; *below*: palea adjacent to the rachilla, concave on the external surface, keeled at the 2 veins. (*e*) Adaxial view of floret; awn single, scabrous, arising from an unnotched apex; lemma surface mainly glabrous but scaberulous near the awn and at the base; palea almost as long as the body of the lemma. Approximately 6×. (*f*) Gynoecium apex with many long hairs; styles free and stigmatic to the base; stigma with many single branches. Approximately 60×. *Inset*: stigmatic branches with many small projections. Approximately 400×. (*g*) Lodicules membranous, toothed, apically pubescent. Approximately 60×.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Anthers 3. Ovary apex pubescent; styles free to the base; stigmas white or yellow brown. $x = 7$.

Recent Canadian floras, Scoggan (1978), Looman and Best (1979), and Dore and McNeill (1980) have followed Hitchcock and Chase (1951) in a traditional generic treatment of the tribe Triticeae. Other authors, Tzvelev (1976), Melderis (1980), and Löve (1980) circumscribe the genera of the Triticeae differently. For *Agropyron* and *Elymus*, the lists of species in Western Canadian cattle rangelands given here follow the generic limits adopted by Hitchcock and Chase (1951), but synonyms and some of the names used by other authors are indicated in brackets after each name. Intrageneric hybrids are common in *Agropyron*. To minimize the confusion they have been excluded from the list.

Agropyron albicans Scribner & J. G. Sm. [*Elymus albicans* (Scribner & J. G. Sm.) A. Löve]

A. bakeri E. Nelson [based on incorrectly identified specimens, see Boivin 1981, p. 92]

A. cristatum (L.) Gaertner [*Eremopyrum cristatum* (L.) Willk.]

A. dasystachyum (Hooker) Scribner [*Elymus lanceolatus* (Scribner & J. G. Sm.) Gould, non *E. dasystachys* Trin., *Elytrigia dasytachya* (Hooker) A. & D. Löve]

A. desertorum (Fischer ex Link) Schultes [*A. sibiricum* var. *desertorum* (Fischer ex Link) Boiss.]

A. intermedium (Host) Beauv. [*Elytrigia intermedia* (Host) Nevski]

A. latiglume (Scribner & J. G. Sm.) Rydb. [*A. trachycaulum* var. *latiglume* (Scribner & J. G. Sm.) Beetle]

A. pectiniforme Roemer & Schultes [*A. cristatum* auct. amer., *A. cristatum* subsp. *pectinatum* (Bieb.) Tzvelev]

A. repens (L.) Beauv. [*Elytrigia repens* (L.) Nevski]

A. riparium Scribner & J. G. Sm. [*A. dasystachyum* var. *riparium* (Scribner & J. G. Sm.) Bowden, *Elymus rydbergii* Gould, non *E. riparius* Wieg.]

A. scribneri Vasey [*Elymus scribneri* (Vasey) M. E. Jones]

A. sibiricum (Willd.) Beauv. [*A. fragile* subsp. *sibiricum* (Willd.) Melderis]

A. smithii Rydb. [*Elytrigia smithii* (Rydb.) A. Löve]

A. spicatum (Pursh) Scribner [*Pseudoroegneria spicata* (Pursh) A. Löve]

A. subsecundum (Link) A. S. Hitchc. [*A. trachycaulum* var. *unilaterale* (Cassidy) Malte, *A. pauciflorum* (Schw.) A. S. Hitchc. ex Silveus]

A. trachycaulum (Link) Malte ex H. F. Lewis [*Elymus trachycaulus* (Link) Gould ex Shinners, *A. caninum* auct. amer.]

var. *glaucum* (Pease & A. H. Moore) Malte

var. *latiglume* (Scribner & J. G. Sm.) Beetle [*A. violaceum* (Hornem.) Lange]

var. *majus* (Vasey) Fern [*Elymus trachycaulus* subsp. *major* (Vasey) Tzvelev]

var. *novae-angliae* (Scribner) Fern. [*Elymus trachycaulus* subsp. *novae-angliae* (Scribner) Tzvelev]

var. *unilaterale* (Cassidy) Malte [*A. subsecundum* (Link) A. S. Hitchc., *Elymus trachycaulus* subsp. *subsecundus* (Link) A. & D. Löve, *A. pauciflorum* (Schw.) A. S. Hitchc. ex Silveus]

A. triticeum Gaertner [*Eremopyrcum triticeum* (Gaertner) Nevski]

A. violaceum (Hornem.) Lange [*A. latiglume* (Scribner & J. G. Sm.) Rydb., *A. trachycaulum* var. *latiglume* (Scribner & J. G. Sm.) Beetle, *Elymus trachycaulus* subsp. *violaceus* (Hornem.) A. & D. Löve]

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30. ×*Elyhordeum* Mansf.

The "generic name" for hybrids between *Elymus* and *Hordeum*. These combine the characteristics of both genera and have spikelets in twos or in threes on the rachis. Nine such hybrids are recorded by Bowden (1967), two of these were produced artificially. One has been collected at least twice in Saskatchewan.

Tufted perennials, to 1 m high. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths glabrous, open; margins overlapping, hyaline; ligules membranous, entire or lacerate; auricles absent; collars indistinct, divided; blades rolled in bud, flat; surfaces pubescent to almost glabrous; margins scabrous.

Inflorescence a spike; rachis flattened, winged, marginally stiffly ciliate, with a minute involucral flap on each node at the base of the spikelets. Spikelets laterally compressed, disarticulating above the glumes, usually with one, well formed, basal floret and several reduced florets above; rachilla glabrous or puberulent. Glumes equal, scabrous, 1-nerved, setaceous, tapering to an awn. Lemmas rounded on the back, glabrous, except for scabrous projections on and at the base of the single, straight awn. Paleas as long as the lemmas, green, keeled and scaberulous at the 2 nerves. Lodicules 2, free, distally membranous, pubescent with toothed margins. Anthers 3, thin walled, often abnormal. Ovary often withered, apex pubescent; styles free to the base; stigmas white. $x = 7$.

×*Elyhordeum montanense* (Scribner) Bowden: *Elymus virginicus* L. × *Hordeum jubatum* L.

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31. *Elymus* L.

Fig. 26

Coarse perennials, often 1–2 m high, usually tufted and without rhizomes. Culms erect, glabrous; nodes usually exposed; upper culm internodes hollow (except *E. cinereus*). Sheaths open; margins overlapping; ligules membranous, often erose–ciliolate or with apical hairs, usually less than 2 mm long (2–7 mm *E. cinereus*); auricles clawlike or sometimes rounded, sometimes delicate and early deciduous; collars variable; blades rolled in bud, flat or involute at maturity, usually

0.4–1.2 cm wide; upper surface variable, lower surface hairless, with or without scabrous projections; margins scabrous or scaberulous.

Inflorescence a spike; rachis flattened, scabrous or pubescent on the margins, usually with 2, sometimes 1–6, spikelets at the nodes, these often subtended by a short, involucral flap or fringe of hairs. Spikelets laterally compressed, disarticulating above the glumes and between the 2–several florets; rachilla turned at the base so that florets are more or less dorsiventral to the rachis and do not appear 2-ranked, prolonged beyond the uppermost fertile floret. Glumes equal to unequal, generally thick and hard, sometimes setaceous, oriented toward the abaxial side of each spikelet, 1–3-nerved, awned or awnless. Lemmas almost equaling the upper glume, rounded on the back, glabrous to pubescent, with 5–7 nerves converging toward the apex, with or without a single, straight awn, to 3 cm long. Paleas almost as long as lemmas, colored, keeled and pubescent on the outer surface at the 2 nerves. Lodicules 2, free, distally membranous, pubescent, with or without the margin toothed. Anthers 3, yellow. Ovary apex densely pubescent; styles free to the base; stigmas usually white or golden. $x = 7$.

Elymus angustus Trin. [*Leymus angustus* (Trin.) Pilger]
E. arenarius L. [*Leymus arenarius* (L.) Hochst.]
E. canadensis L.
E cinereus Scribn. & Merr. [*E. condensatus* var. *pubescens* Piper; *E. piperi* Bowden]
E. diversiglumis Scribner & C. R. Ball [*E. interruptus* Buckley]
E. glaucus Buckley
[*E. hirtiflorus* A. S. Hitchc., see ×*Agroelymus hirtiflorus* (A. S. Hitchc.) Bowden]
E. hystrix L. [*Hystrix patula* Moench]
E. innovatus Beal [*Leymus innovatus* (Beal) Pilger]
E. junceus Fischer [*Psathyrostachys juncea* (Fischer) Nevski]
E. mollis Trin. [*Leymus mollis* (Trin.) Pilger; *E. arenarius* subsp. *mollis* (Trin.) Hulten; *E. arenarius* var. *villosus* E. H. F. Meyer]
E. virginicus L.

References

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Church, G. L. 1954. Interspecific hybridization in eastern *Elymus*. Rhodora 56:185–197.

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Fig. 26. *Elymus* and ×*Agrohordeum*. (*a*–*f*) *E. canadensis*. (*a*) Whole plant, tufted perennial with basal and culm leaves; culm nodes exposed; inflorescence immature, with sheath surrounding the base; awns straight, parallel to the rachis. Approximately 0.35×. (*b*) Rachis internode, with 2 nodes and spikelets in pairs at each node, spikelets sessile, with 2–3 florets. Approximately 2.5×. (*c*) Mature inflorescence; spikelet arrangement more open, awns diverge in characteristic sweeping curves. Approximately 0.4×. (*d*) Glumes equal, 3-nerved, broader toward the base, but less than 2 mm wide, tapering to a single, scabrous awn. Approximately 3×. (*e*) Three nodes of rachis with spikelets removed; rachis flattened, concave on the side where the spikelet cluster was attached, convex on the opposite side and appearing to zigzag; edges with rows of short, stiff trichomes, becoming longer toward the top of each internode. Approximately 1.3×. (*f*) Lemma tapering to a scabrous awn and surrounding an apically notched palea almost as long as the body of the lemma, apically notched. Approximately 3×. (*g*) ×*A. macounii*. Spikelet node with 3 florets; *left*: sessile floret with single, awned glume expanded at the base; lemma awned; palea as long as the lemma; *center*: pedicellate floret with awned lemma behind, in front the rachilla extending with reduced lemma at the apex; *right*: two glumes subtending the central floret; outer, lower glume setaceous, similar to *Hordeum* glumes; inner, upper glume, broader at the base, 2-nerved, tapering to an apical awn. Approximately 3×.

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32. *Eremopyrum* (Ledeb.) Jaub. & Spach

Tufted annuals, to 35 cm high. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths glabrous to puberulent, open; margins overlapping, hyaline; ligules membranous, usually lacerate, 0.5–2.0 mm high; auricles clawlike, to 1 mm long; collars distinct, constricted, divided; blades rolled in bud, flat to involute at maturity, 1–4 mm wide, articulate at the collars; surfaces pubescent; margins scabrous.

Inflorescence a short, bilateral spike of single crowded spikelets; rachis flattened, zigzag, disarticulating slowly at maturity, the margins stiff, ciliate. Spikelets laterally compressed, disarticulating above the glumes and between the 2–6 florets; rachilla scaberulous, prolonged beyond the uppermost fertile floret. Glumes almost equal, thick, glabrous or scaberulous, membranous on the margins, keeled at 1–2

nerves, tapering to an acuminate apex. Lemmas rounded on the back, glabrous or with short, sparse pubescence, with 5 nerves converging at an attenuate apex. Paleas shorter than the lemmas, keeled, colored, puberulent at the 2 nerves. Lodicules 2, membranous, toothed, and with a few stiff trichomes on the margins. Anthers 3. Ovary apex pubescent; styles free to the base; stigmas white. $x = 7$.

Eremopyrum triticeum (Gaertner) Nevski [*Agropyron triticeum* Gaertner]. Introduced from Russia, escaped and growing locally in the Prairie Provinces.

Scoggan (1978) places this species in *Agropyron*. Cronquist et al. (1977) recognize *Eremopyrum* as a separate genus claiming that the annual habit and distinctive morphology and cytology readily distinguish it from any of the perennial agropyrons. It is recognized as a separate genus by Tzvelev (1976), Baum (1978), and Melderis (1980), but not by Gould (1951, 1968).

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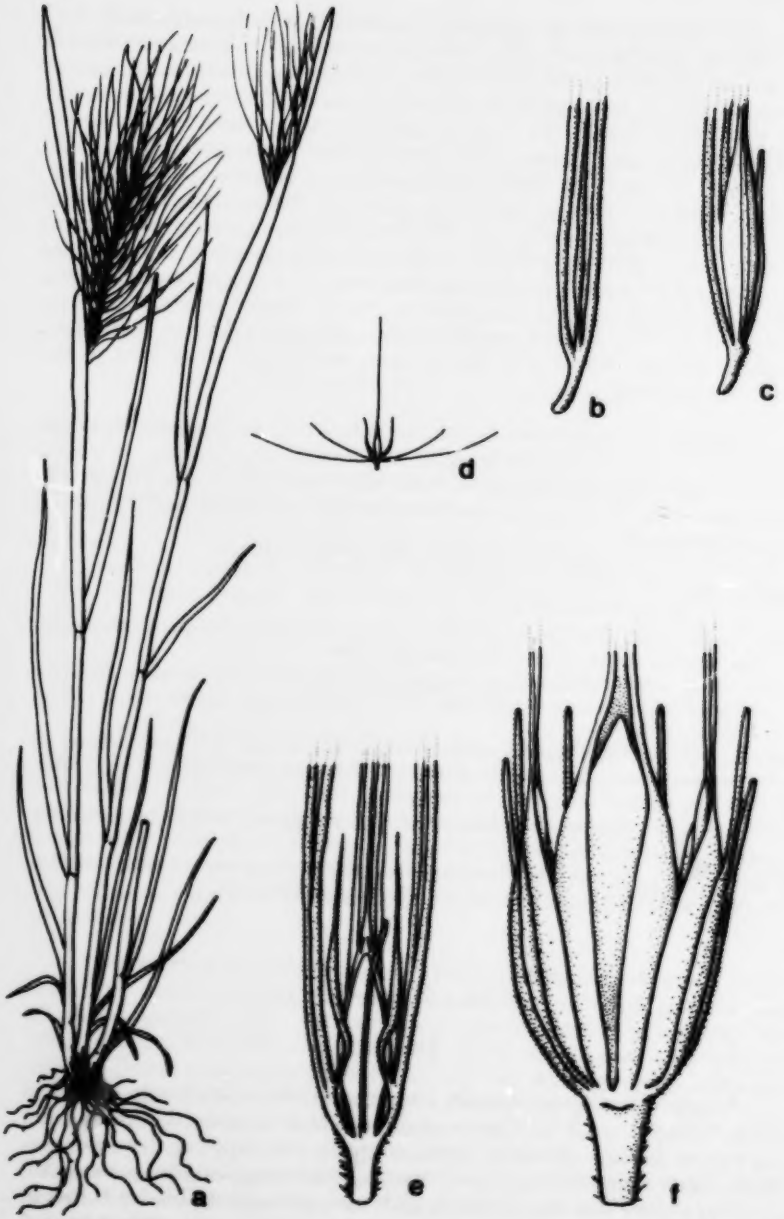
33. *Hordeum* L.

Fig. 27

Tufted annuals and perennials, usually less than 1 m high. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths open; margins overlapping; ligules membranous, entire or lacerate, to 1 mm long; auricles variable, clawlike, rounded, sometimes rudimentary or absent; collars variable; blades rolled in bud, flat at maturity; surfaces pubescent, scabrous, or glabrous; margins scabrous.

Fig. 27. *Hordeum*. (*a–e*) *H. jubatum*. (*a*) Whole plant, base tufted; leaves basal and cauline; *right*: uppermost leaf sheath expanded, enclosing a developing inflorescence bristling with glumes that are long and setaceous, and lemma awns. Approximately 0.35×. (*b*) Sterile spikelet with 2 long, setaceous glumes, and pedicellate sterile lemma. Approximately 10×. (*c*) Side view of fertile spikelet; *left*: 2 setaceous glumes; *center*: lemma rounded and tapering to an awn; *right*: rachilla prolonged as a scabrous bristly extension. Approximately 10×. (*d*) Disarticulation unit; rachis disarticulating just above the 3 spikelets at each node. Note: lemma awn and glumes more than 10× length of body of lemma. Actual size. (*e*) Disarticulation unit (awn length not shown); central fertile spikelet sessile, with 2 glumes, lemma awn, and bristle rachilla; *left* and *right*: sterile pedicellate spikelets; *below*: rachis internode pubescent. Approximately 10×. (*f*) *H. vulgare*. Disarticulation unit; 3 fertile, sessile spikelets; 3 long, lemma awns (full length not shown); 6 setaceous glumes varying in length but usually not much longer than the body of the lemma. Approximately 10×.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Inflorescence a dense spike with 3 spikelets at each node, the central one fertile, usually sessile, the lateral ones pedicellate, usually sterile (all sessile and fertile in cultivated barley, *H. vulgare*), disarticulating at the main axis above each node, the short internodes remaining attached to the base of the 3 spikelets. Central spikelet with 1 sessile, fertile flower; lateral spikelets pedicellate, often represented by glumes only; rachilla prolonged beyond the flower and sometimes bearing a rudimentary floret. Glumes equal or subequal, narrow, flat or setaceous, often positioned abaxially to the spikelet, 0–5 nerves tapering to a single, straight awn. Lemmas rounded on the back, glabrous, scabrous, or with scattered hairs, with 5 nerves tapering toward a single, straight awn. Paleas almost as long as the lemmas, green, keeled at the 2 nerves. Lodicules 2, free, distally membranous, pubescent, with or without a toothed margin. Anthers 3. Ovary apex pubescent; styles free to the base; stigmas white. $x = 7$.

Hordeum brachyantherum Nevski, *H. jubatum* L., *H. pusillum* Nutt., *H. vulgare* L. *Hordeum glaucum* Steudel, a Eurasian introduction, is known from along a dry roadside near Jasper National Park. It was collected in 1949 by G. H. Turner. No evidence of its continued occurrence in Canada is known.

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34. *Secale* L.

Fig. 28

Annuals (in Canada usually winter annuals), resembling wheat but often higher, to 1.2 m. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths open; margins overlapping, hyaline, glabrous; ligules membranous, lacerate, to 1 mm long; auricles prominent, clawlike; collars distinct, divided, glabrous, pale green; blades rolled in bud, flat at maturity, usually scabrous, but occasionally with scattered trichomes; margins smooth or scaberulous.

Inflorescence a dense, bilateral spike; rachis flattened with long trichomes on the margins. Spikelets solitary, laterally compressed in a plane of compression parallel to the rachis, disarticulating above the glumes, usually 2-flowered; rachilla pubescent, prolonged beyond the uppermost fertile floret. Glumes equal, shorter than the adjacent lemmas, setaceous, 1(−3)-nerved, keeled and puberulent at the central nerve, tapering to a short, scabrous awn. Lemmas broad, keeled sometimes asymmetrically, 5-nerved, tapering to a long, straight, scabrous awn. Paleas as long as the lemmas, green at the 2 veins, and laterally compressed at each vein, forming 2 keels and a deep inverted pleat with a ridge in the center of the palea. Lodicules 2, free, apically membranous, toothed, with long trichomes. Ovary apex pubescent; styles free to the base; stigmas white. $x = 7$.

Secale cereale L. (cultivated rye).

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35. *Sitanion* Raf.

Tufted, short-lived perennials, less than 0.5 m high. Culms glabrous; nodes rarely exposed except in alpine specimens; upper culm internodes hollow. Sheaths glabrous to densely pubescent, open; margins overlapping, hyaline; ligules membranous, entire or lacerate, to 1 mm long, sometimes minutely erose; auricles clawlike when present; collars continuous, sometimes indistinct; blades rolled in bud, flat at maturity, to 6 mm wide, usually puberulent; margins with scabrous projections.

Inflorescence a spike, usually with 2 spikelets at each node; rachis flattened, disarticulating, the segments falling with the spikelet pair attached apically, the curving awns mechanically separating the inflorescence. Spikelets disarticulating above the glumes and between the 2−4 flowers, the uppermost floret reduced. Glumes equal, indurate, scabrous, setaceous, 1−3-nerved, apex extending to a long, stout, awn. Lemmas rounded and stiffly pubescent on the back, with 5 nerves converging at the base of a single, straight or curved awn, to 5 cm long. Paleas almost the length of the lemmas, green, keeled, pubescent at the 2 nerves that sometimes extend as 2 short awns, to 5 mm long. Lodicules 2, free, distally membranous, pubescent, with toothed margins. Anthers 3. Ovary apex pubescent; styles free to the base; stigmas white. $x = 7$.

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Fig. 28. *Secale* and *Triticum*. (*a*–*c*) *S. cereale*. (*a*) Whole spike; spikelets arranged in sessile pairs at each node, pairs alternating along a flattened rachis; mature lemma awns straight, paralleling spike rachis. Approximately 0.67×. (*b*) Rachis node with pair of sessile spikelets; glumes equal, shorter than lemma, minutely scaberulous; lemmas strongly laterally compressed with long, stiff cilia on keel and margins, shorter stiff cilia on awns; paleas as long as body of lemma. Approximately 4×. (*c*) Palea pleated, laterally compressed at each vein forming 2 keels and a deep, inverted pleat in the center of palea with a distinct ridge. Approximately 5×. (*d*–*g*) *Triticum*. (*d*) *T. aestivum*. Spikelets with 2–5 florets, alternating on rachis; lemmas with mucronate tip or occasionally a short awn. (In this drawing the veins are prominent and lemmas glabrous, but these characters vary.) Actual size. (*e*–*g*) *T. turgidum*. (*e*) Spike; spikelets with 2–3 florets, basal florets often awnless, others with conspicuous awns to more than 20 times lemma body length. Approximately 0.5×. (*f*) Spikelet with 2 florets; glumes and lemmas with single awns. Approximately 4×. (*g*) Palea concave on outer surface between the 2 veins, not pleated. Approximately 4×.

Sitanion hystrix (Nutt.) J. G. Sm. Reported from subalpine and alpine meadows in British Columbia, from lower altitudes in Alberta and Saskatchewan, but not known from Manitoba. It is known to hybridize with species of *Agropyron* and *Elymus* in other parts of its range.

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36. *Triticum* L.

Fig. 28

Tufted annuals, usually commercially cultivated, but occasionally escaping. Culms glabrous or puberulent; nodes exposed; upper culm internodes hollow. Sheaths open, glabrous; margins overlapping, hyaline, usually glabrous, sometimes pubescent; ligules membranous, lacerate, 1–2 mm long; auricles usually well developed, clawlike; collars indistinct, divided; blades rolled in bud, becoming flat, vestiture variable.

Inflorescence a bilateral spike; rachis flattened and hollowed, pubescent on the margins. Spikelets sessile, solitary at nodes of the rachis, laterally compressed, eventually disarticulating above the glumes and between the 2–5 florets; rachilla pubescent, prolonged beyond the

uppermost fertile floret. Glumes equal or subequal, thick and firm, asymmetrically keeled, with 3–many nerves, mucronate or awned. Lemmas with or without a keel, glabrous, with 5–7 or more nerves that converge toward apex, with or without a single, straight awn 0–15 cm long. Paleas as long as the lemmas, pubescent, green, keeled at the 2 nerves. Lodicules 2, free, basally fleshy, apically membranous, pubescent. Anthers 3. Ovary apex pubescent; styles free to the base; stigmas white. $x = 7$.

Triticum aestivum L. (hexaploid wheat, including bread wheats and pastry flour wheats), and *T. turgidum* L. (tetraploid wheat, including durum and macaroni wheats).

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Tribe Meliceae

37. *Catabrosa* Beauv.

Aquatic perennials 10–80 cm high, with long, decumbent stems and stolons rooting at the nodes. Culms glabrous; culm nodes exposed; upper culm internodes hollow. Sheaths glabrous, often purplish toward the base, closed to near the top; margins not overlapping, hyaline; ligules membranous, entire to erose, to 8 mm long; auricles absent; collars distinct, continuous; blades folded in bud, flat, at maturity 3–8 mm wide; surfaces glabrous; margins glabrous or scaberulous.

Inflorescence an open panicle. Spikelets laterally compressed, disarticulating above the glumes and between the 1–2 awnless florets; rachilla glabrous, not extended beyond the uppermost floret or present as an inconspicuous reduced remnant. Glumes unequal, shorter than the lemmas, obtuse, irregularly toothed or erose at the apex, nerveless or the upper faintly 1–3 nerved. Lemmas glabrous and rounded on the back, apex blunt, with 3 prominent nerves that do not converge. Paleas about as long as the lemmas, glabrous, green at the 2 nerves. Lodicules 2, free, distally membranous, toothed or untoothed. Anthers 3. Ovary apex glabrous; styles free to the base; stigmas white. $x = 10$.

Catabrosa aquatica (L.) Beauv. The only North American representative in a genus of seven species.

38. *Glyceria* R. Br.

Aquatic or wetland perennials, often 1 m or more high; usually rhizomatous, sometimes decumbent at the base and freely rooting at the nodes. Culms glabrous; nodes exposed or not; upper culm internodes hollow. Sheaths glabrous, closed to near the top, sometimes splitting easily; margins hyaline; ligules membranous, entire or lacerate, sometimes apically erose, usually less than 5 mm long (to 15 mm in *G. borealis*); auricles absent, collars variable; blades folded in bud, flat at maturity, 0.5−1.5 cm wide, usually glabrous; margins smooth or scaberulous.

Inflorescence an open or contracted panicle. Spikelets laterally compressed, disarticulating above the glumes and between the 2−12 awnless florets. Glumes subequal to unequal, shorter than the lemmas, dorsally rounded, usually 1-nerved. Lemma callus not bearded; lemmas rounded on the back, 5−9-nerved, usually 7-nerved, the nerves parallel, not converging toward apex. Paleas approximately the length of the lemmas, green or purplish, keeled at the 2 nerves. Lodicules fleshy at least at the base, the apical surface often papillate; in some species clearly 2, fused at the base, in others lodicules are reduced to a low collar, the extent of the fusion varies within species. Anthers (2)3, yellow or purple. Ovary apex glabrous; styles free to the base; stigmas white. $x = 10$.

Glyceria borealis (Nash) Batchelder, *G. elata* (Nash) M. E. Jones, *G. grandis* S. Watson, *G. pulchella* (Nash) K. Schum., *G. striata* (Lam.) A. S. Hitchc.

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39. *Schizachne* Hackel

Fig. 29

Tufted perennials, to 1 m high, unbranched, with decumbent stems from short thin rhizomes. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths initially closed to near the apex, usually splitting with advanced maturity; margins not overlapping, hyaline; ligules membranous, lacerate, to 1 mm long; auricles absent; blades rolled in bud, flat or loosely involute at maturity, 1−5 mm wide, narrowed at the base; surfaces scabrous to glabrous.

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Fig. 29. *Schizachne purpurascens*. (*a*) Whole plant, tufted, leaves basal and cauline. Approximately 0.1×. (*b*) Plant base with decumbent stems and a short, thin rhizome. Actual size. (*c*) Junction of the leaf sheath and the blade; sheath closed to near the apex; ligule lacerate, extending at margins as sheath auricles. Approximately 5×. (*d*) Spikelet with subequal glumes and 4 florets. Approximately 6×. (*e*) Abaxial view of floret; callus bearded; lemma with an apical notch at the base of a curved awn. Approximately 6×. (*f*) Adaxial view of floret; palea shorter than the lemma, keeled and stiffly ciliate at the 2 veins. Approximately 6×.

Inflorescence a simple panicle or loose raceme of spikelets borne on thin, scabrous pedicels. Spikelets laterally compressed, readily disarticulating above the glumes and between the 3–7 florets; rachilla glabrous or scaberulous, prolonged beyond the uppermost fertile floret. Glumes subequal or unequal, rounded on the back, glabrous; lower glume 1-nerved; upper glume 3–5-nerved. Lemma callus bearded; lemmas rounded and scabrous on the back, apex acute, the 7 nerves converging toward an apical notch at the base of a curved, 1–2 cm long awn. Paleas two-thirds of the length of the body of the lemmas, keeled and pubescent at the 2 veins. Lodicules 2, fused at the base, free apically, distally fleshy and rounded. Anthers 3. Ovary apex glabrous; styles free to the base; stigmas white. $x = 10$.

Schizachne purpurascens (Torrey) Swallen.

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Tribe Stipeae

40. *Oryzopsis* Michaux

Fig. 30

Tufted perennials, to 70 cm high. Culm glabrous, rarely scabrous; nodes exposed; upper culm internodes usually hollow (solid, *O. hymenoides*). Sheaths open; margins overlapping, usually hyaline and glabrous; ligules membranous, lacerate or entire, 5 mm long or less; auricles absent; collars indistinct; blades rolled in bud, flat or involute and setaceous at maturity; surfaces usually scabrous or glabrous; margins scabrous.

Inflorescence an open or contracted panicle, or a spike. Spikelets not strongly compressed, disarticulating above the glumes, 1-flowered; rachilla not extended. Glumes 2, equal or subequal, dorsally rounded, usually glabrous, occasionally scaberulous, 1–5-nerved. Lemma callus bearded in some species; lemmas rounded on the back, indurate,

pubescent (glabrous, *O. micrantha*), with 5–9 veins converging toward the awned apex; awn deciduous, sometimes falling off before flowering, straight or curved, less than 2 cm long. Paleas almost as long as the lemmas, colored, rounded and often pubescent between the 2 nerves. Lodicules 2–3, or 2 large and 1 vestigal lodicule, free, distally membranous, with and without toothed margins. Anthers 3. Ovary apex glabrous; styles free to the base; stigmas white. $x = 5, 6, 11, 12$.

Oryzopsis asperifolia Michaux, *O. canadensis* (Poiret) Torrey, *O. exigua* Thurber, *O. hymenoides* (Roemer & Schultes) Ricker, *O. micrantha* (Trin. & Rupr.) Thurber, *O. pungens* (Torrey) A. S. Hitchc.

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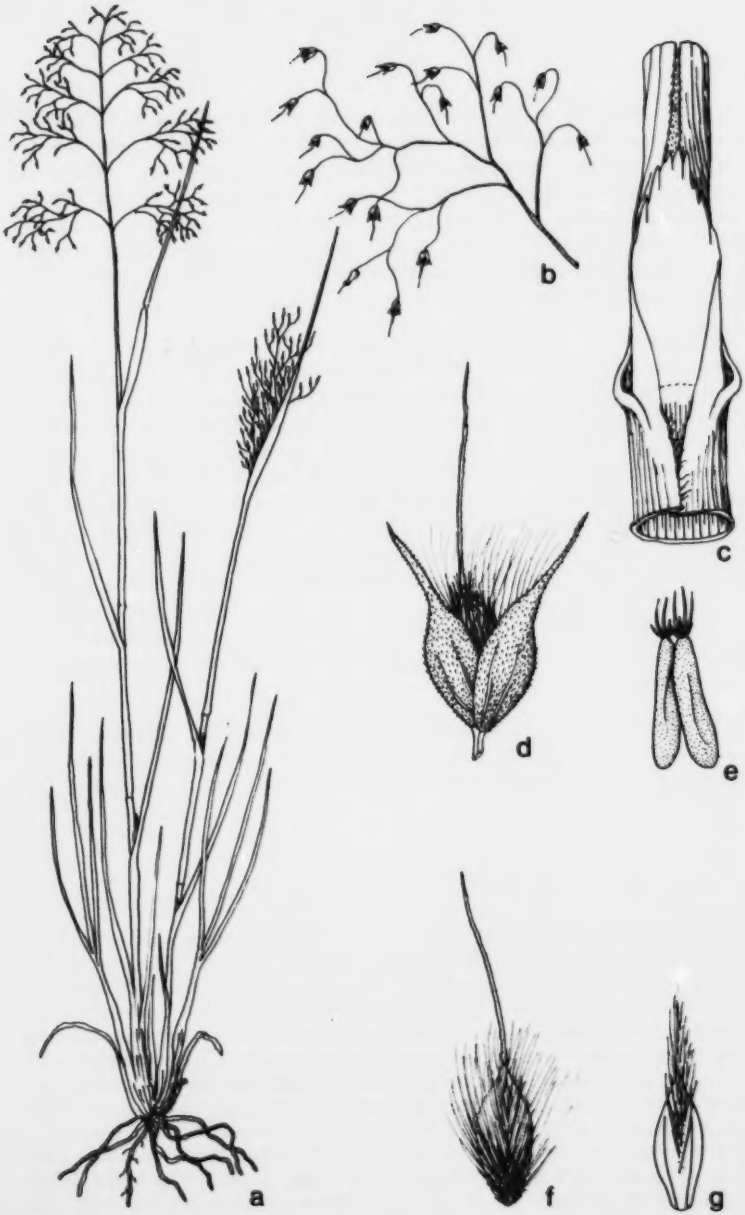
Fig. 30. *Oryzopsis hymenoides*. (*a*) Whole plant, base tufted, with remains of previous season's growth; nodes exposed, glabrous; leaves flat or setaceous, borne basally and on the culms; *left*: mature inflorescence open and diffuse; *right*: young inflorescence surrounded by expanded flag leaf. Approximately 0.4×. (*b*) Portion of mature inflorescence with single-flowered spikelets borne on long, glabrous, capillary rachis branches. Approximately 0.7×. (*c*) Junction of the sheath and the blade; ligule membranous, lacerate, and decurrent with the overlapping sheath margins, only the exposed margin is ciliate, elsewhere sheath is glabrous; sheath auricles present; adaxial blade surface pubescent, abaxial surface glabrous; margins with scabrous projections. Approximately 5×. (*d*) Mature spikelet; glumes equal, central vein extending to acuminate apex, 2 lateral veins on each side extending about half the length of the glume; outer surface pubescent; lemma surface, indurate, with long, silky hairs; the single awn straight and puberulent. Approximately 5×. (*e*) Anther with a few, stiff, ciliate trichomes at the apex. Approximately 10×. (*f*) Mature lemma with shorter hairs of callus merging with longer hairs on the dorsal lemma surface; apical awn short and straight, with hairs covering base. Approximately 5×. (*g*) Palea with long, silky hairs between the 2 veins, only on the palea surface not enclosed by lemma, elsewhere palea glabrous. Approximately 5×.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41. *Stipa* L.

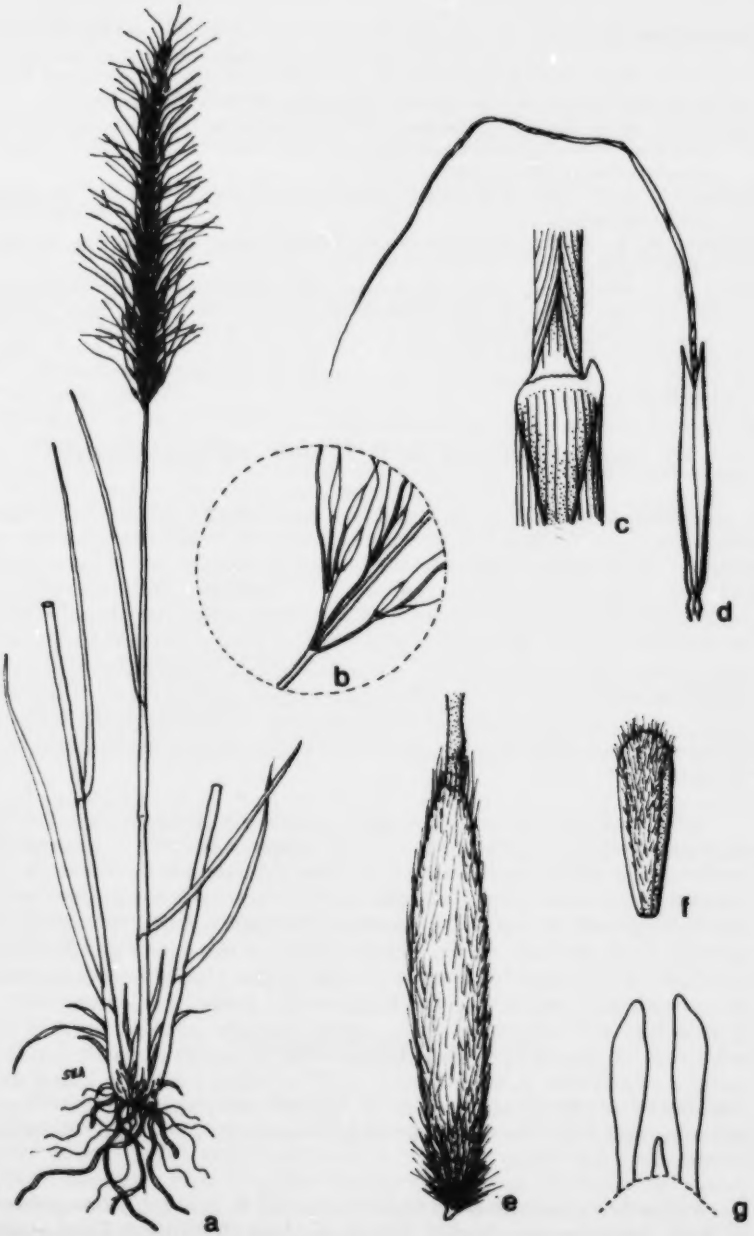
Fig. 31

Tufted perennials, to 1 m high; leaves mostly basal. Culms usually glabrous, sometimes pubescent; nodes exposed; upper culm internodes spongy or hollow. Sheaths open; margins overlapping, ciliate to glabrous, sometimes extended as 1–2 short, erect sheath auricles; ligules membranous, entire or lacerate, 0.5–6 mm long; collars indistinct; blades folded or rolled in bud, mostly setaceous; upper blade surface with or without hairs, with scabrous projections, lower blade surface and margins hairless, with or without scabrous projections.

Inflorescence an open or loosely contracted panicle. Spikelets more or less terete, disarticulating above the glumes, 1-flowered. Glumes 2, equal or subequal, longer than the lemmas, usually rounded on the back, 1–5-nerved, membranous, acuminate. Callus usually sharp-pointed and bearded; lemmas indurate, terete; margins usually overlapping, distally glabrous or pubescent, usually with a ring of longer hairs on the lemma at the base of the apical awn, the 5 nerves converging just below the stout, twisted, and geniculate awn, 5–200 mm long, persistent or tardily deciduous. Paleas varying from a quarter to almost the length of the lemmas, usually (0–)2(–5)-nerved, often pubescent between the nerves. Lodicules 2–3, long and straplike, glabrous to a quarter the length of the lemma; the middle one usually shorter or absent; without toothed margins. Anthers 3. Ovary apex glabrous; styles free to the base; stigmas white. $x = 5, 6, 11, 12$.

Stipa comata Trin. & Rupr., *S. curtiseta* (A. S. Hitchc.) Barkworth, *S. lemmonii* (Vasey) Scribner, *S. nelsonii* Scribner, [*S. occidentalis* Thurber, *S. columbiana* Macoun], *S. richardsonii* Link, *S. spartea* Trin., *S. viridula* Trin.

Fig. 31. *Stipa nelsonii*. (*a*) Whole plant, caespitose; usually setaceous leaves both basal and cauline; paniculate inflorescence compact, spikelike. Approximately 0.2×. (*b*) Rachis node with 3 branches at a node and single-flowered spikelets borne on pedicels of varying lengths. Approximately 1.3×. (*c*) Junction of the leaf sheath and the blade; sheath glabrous; sheath margins sometimes extending as erect, membranous, often asymmetric sheath auricles; ligule membranous with crenulate apex; blade setaceous with margins inrolled. Approximately 4×. (*d*) Spikelet with 1 floret; lemma completely enclosed in equal, puberulent glumes; lemma awn spirally twisted. Approximately 5×. (*e*) Lemma body with covering of long hairs, and at base a pointed, more densely bearded callus; awn terminal. Approximately 10×. (*f*) Palea flat or rounded on the back and at the apex; pubescent between the 2 marginal veins. Approximately 10×. (*g*) Lodicules 2–3, straplike, membranous, glabrous; the third lodicule varying from approximately half the size of the others to absent. Approximately 20×.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Tribe Paniceae

42. *Dichanthelium* (A. S. Hitchc. & Chase) Gould

Tufted perennials with 3 distinct seasonal growth forms. Culms simple, with a terminal inflorescence produced in the spring from an overwintering basal rosette of short, broad leaves. In late summer and fall, culms produce axillary fascicles and branches that bear axillary panicles. Spikelets often cleistogamous during autumnal phase. Culms erect or decumbent, glabrous to pubescent; at least some nodes exposed; upper culm internodes solid or spongy. Sheaths rounded on the back, usually densely pubescent or puberulent, open; ligules ciliate fringes of hairs less than 1 mm long; auricle positions sometimes with tufts of hairs; collars variable; culm blades rolled in bud becoming flat, vestiture variable.

Inflorescence a more or less open panicle with the spikelets on long or short pedicels. Spikelets ovate to elliptic, dorsally compressed, awnless, disarticulating below the glumes, 2-flowered, the lower floret sometimes staminate, more usually sterile. Glumes unequal, the lower one often greatly reduced, 0–3-nerved, the upper glume as long as the spikelet, 7–11-nerved. Sterile lemma similar to the upper glume, often associated with a membranous or hyaline palea. Upper hermaphrodite florets with glabrous, coriaceous lemmas and paleas, the lemmas with 5 faint nerves that converge at the apex; margins inrolled around the palea that is almost the same length. Paleas 2-nerved, with inrolled margins. Lodicules 2, free, fleshy, with margins entire or lobed and undulating at the apex. Anthers 3, purple or reddish. Ovary apex glabrous; styles free to the base; stigma brownish or pink to purplish. $x = 9$.

Dichanthelium acuminatum (Swartz) Gould & Clark [*D. lanuginosum* Ell.], *D. depauperatum* (Muhl.) Gould, *D. leibergii* (Vasey) Freckmann, *D. linearifolium* (Scribner) Gould [*D. perlongum* (Nash) Freckmann],

D. oligosanthes (Schultes) Gould [including *D. wilcoxianum* (Vasey) Freckmann], *D. xanthophysum* (A. Gray) Freckmann.

Dichanthelium was considered to be a subgenus of *Panicum* (Hitchcock and Chase 1953), but it was raised to generic status by Gould (1974).

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43. *Digitaria* Heister ex Fabr.

Annuals, usually less than 0.5 m high. Culms erect or decumbent, sometimes stoloniferous, spreading along the ground and rooting at the lower nodes; upper nodes sometimes exposed; upper culm internodes hollow. Sheaths ciliate or glabrous, open; margins overlapping; ligules membranous, dentate or lacerate without pubescence, 1–2 mm long; collars distinct, divided; blades rolled in bud, flat at maturity, with or without long trichomes on the blade surfaces and margins.

Inflorescence a digitate panicle of 2–10 spikelike racemes; rachis flattened, 3-angled. Spikelets usually in pairs, one subsessile, the other pedicellate, borne in 2 rows on 2 sides of the rachis midrib; spikelets dorsally compressed, nearly planoconvex, disarticulating below the glumes, awnless. Glumes unequal, the lower glume small or absent, the upper glume from one-half to as long as the spikelet, 3-nerved. Sterile lemmas green, 3–7-nerved, as long as the spikelet, pubescent or glabrous. Fertile lemmas 3-nerved, rounded at the lateral nerves that converge toward the apex, glabrous, sometimes becoming indurate. Paleas as long as the fertile lemmas, glabrous, rounded at the 2 nerves, colored or colorless. Lodicules 2, free, fleshly, apically lobed. Anthers 3, yellow or purple. Ovary apex glabrous; styles free to the base; stigmas golden brown or purple. $x = 9$.

Members of this genus have been introduced to the western provinces several times. Records suggest that often they do not persist, and are present in our area mostly as lawn weeds.

Key to western rangeland species

1. Sheaths and blades with long trichomes; lower glume ovate with acute apex; upper glume narrow, about half the length of spikelet; fertile lemma pale greenish or grayish brown ..... ***D. sanguinalis*** (L.) Scop.
1. Sheaths and blades without trichomes (except associated with the collars); lower glume broad, truncate, or with lobed apex; upper glume as long as spikelet; fertile lemma dark brown, becoming indurate ..... ***D. ischaemum*** (Schreber) Schreber ex Muhl.

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44. *Echinochloa* Beauv.

Fig. 32

Tufted annuals 30–100 cm high, with stout, semisuculent culms, often rooting at the lower nodes. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths compressed, glabrous, open almost to the base; margins overlapping, not hyaline; ligules and auricles absent; collars distinct, continuous, glabrous, yellowish; blades rolled in bud, flat

at maturity, 6–15 mm wide, hairless, with a prominent midrib and with scabrous projections only on the leaf margins.

Inflorescence a moderately open, green to purple panicle, 10–20 cm long, with densely or loosely flowered branches. Spikelets subsessile in irregular clusters, dorsally compressed, disarticulating below the glumes, approximately 3 mm long excluding awns; 2-flowered, the lower floret sterile or staminate, the upper floret perfect. Glumes unequal, 1–3-nerved, the lower glumes less than half the size of the upper glumes, mucronate, with short hairs on the margins, the upper glumes and sterile lemmas about the length of the spikelet with either softly pubescent or with long, 1-celled, stiff trichomes, on the margins and rounded back; nerves converging at the apex, with or without a single, straight awn. Fertile lemmas glabrous, enclosing the paleas at the margins, with 5 faint nerves that converge toward the soft-tipped or mucronate apex. Paleas as long as the lemmas, mucronate, purple or colorless, rounded at the 2 nerves. Lodicules 2, free, distally fleshy, apically lobed. Anthers 3, purple or reddish. Ovary apex glabrous; styles free to the base; mature stigmas purple or brown. $x = 9$.

Echinochloa crusgalli (L.) Beauv., *E. wiegandii* (Fassett) McNeill & Dore [*E. purgens* (Poiret) Rydb. var. *wiegandii* Fassett; *E. occidentalis* auct.], *E. muricata* (Beauv.) Fern.

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Fig. 32. *Echinochloa crusgalli*. (*a*) Whole plant, caespitose; culms semisucculent; leaves flat; inflorescence an erect, open panicle, the spikelets of which have relatively short awns. Approximately 0.35×. (*b*) Spikelet; awn borne on sterile lemma 2–3 times the length of the spikelet. Approximately 3.5×. (*c*) Spikelet; sterile lemma awn is shorter than spikelet. (The variation in the length of awns in this species is illustrated in (*b*) and (*c*); intermediate awns of all lengths may be found.) Approximately 3.5×. (*d*) Junction of the leaf sheath and the blade; ligule absent; blade and sheath glabrous; blade margins with small, scabrous projections. Approximately 2×. (*e*) Lower glume with expanded margins, surrounding the base of the floret, central nerve extending as a mucronate apex; pubescent. Approximately 8×. (*f*) Upper glume, central nerve extending as a mucronate apex; pubescent. Approximately 8×. (*g*) Sterile lemma, similar in texture and appearance to upper glume; usually associated with a colorless membranous palea (not illustrated). Approximately 8×. (*h*) Fertile lemma, dorsally flattened, glabrous, with 5 faint nerves and a patch of minute pubescence at base of abruptly mucronate apex. Approximately 15×. (*i*) Palea as long as lemma, dorsally flattened; sides rounded (bedpan style), surrounding the gynoecium; 2 faint nerves; margins puberulent. Approximately 15×.

45. *Panicum* L.

Fig. 33

Mostly perennials, sometimes 1–2 m high, usually less; without rhizomes (except in *P. virgatum*). Culms glabrous or pubescent; nodes exposed; upper culm internodes spongy or hollow. Sheaths glabrous or pubescent, open; margins overlapping; ligules membranous or a fringe of hairs usually less than 2 mm, sometimes to 5 mm long; auricles absent; collars variable; blades rolled in bud, usually less than 1 cm wide at maturity; surfaces variable, often with hairs and scabrous projections.

Inflorescence an open or contracted panicle. Spikelets more or less dorsiventrally compressed, disarticulating below the glumes, 2-flowered, awnless; lower floret sterile, upper floret fertile; rachilla minute and not prolonged beyond the fertile floret. Glumes usually very unequal in size, the lower 3–7-nerved, about one-quarter the surface area of the upper, this 7–11-nerved, as long as the spikelet, herbaceous, sometimes mucronate, similar in appearance and pubescence to the sterile lemmas. Sterile paleas membranous. Fertile lemmas indurate, dorsally rounded with inrolled margins, colorless, glabrous, usually 5 faint nerves. Fertile paleas as long as the lemmas, rounded, with 2 faint nerves. Lodicules 2, free, fleshy. Anthers 3, red, purple, or yellow. Ovary apex glabrous; styles free or fused toward the base; stigmas golden brown or pink purple. $x = 9, 10$.

Panicum capillare L., *P. miliaceum* L., *P. virgatum* L.

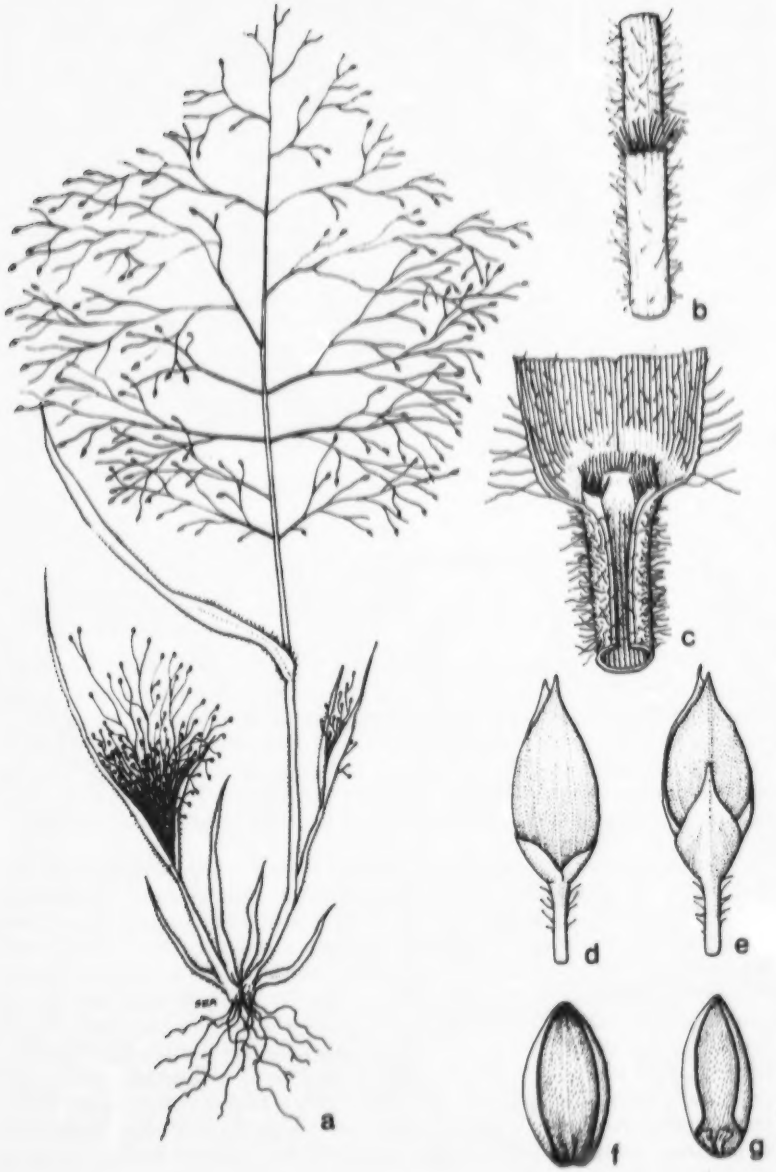
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Fig. 33. *Panicum capillare*. (*a*) Whole plant, caespitose; stems more or less decumbent at the base, sometimes rooting at nodes; annual, without leaf bases from previous season's growth; leaves mostly cauline; inflorescence a diffuse panicle with capillary branches. Approximately 0.7×. (*b*) Culm node with tuft of hairs at node. Approximately 5×. (*c*) Junction of the leaf sheath and the blade; sheath open to the base; ligule a fringe of stiff cilia; lamina, sheath, and margins with covering of long trichomes that are bulbous at base; margins without scabrous projections. Approximately 5×. (*d*) Spikelet, showing lower glume margins expanded, overlapping at base of the mucronate upper glume; *behind*: sterile lemma similar to upper glume. Approximately 10×. (*e*) Spikelet, showing the opposite side of the lower glume, 3-nerved; apex acute, adjacent to 5–7-nerved sterile lemma; *behind*: upper glume overlapping the sterile lemma. Approximately 10×. (*f*) Lemma, dorsally compressed, rounded, margins overlapping the palea, lemma glabrous, with 5 faint nerves. Approximately 12×. (*g*) Palea dorsally compressed, almost as long as lemma; margins overlapping the gynoecium. Lodicules 2, fleshy, apically lobed, adjacent to the base of the palea. Approximately 12×.

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46. *Setaria* Beauv.

Fig. 34

Tufted annuals, usually to 1 m high. Culms mostly decumbent, glabrous; nodes exposed; upper culm internodes usually solid. Sheaths often keeled, open; margins overlapping, sometimes with long hairs on the upper margins, elsewhere glabrous; ligules of hairs to 3 mm long; auricles absent; collars distinct, divided, glabrous, often purplish; blades rolled in bud, becoming flat, upper surface scabrous, sometimes with scattered hairs on the blade adjacent to the ligule; lower surface scabrous, without hairs; margins scabrous or scaberulous.

Inflorescence a spikelike panicle. Spikelets awnless, subtended by 1–several awnlike bristles that exceed the spikelets in length, dorsally compressed, disarticulating below the glumes and above the bristles; 2-flowered, a single, apical, hermaphrodite flower subtended by a staminate flower or 1–2 sterile lemmas. Glumes usually very unequal,

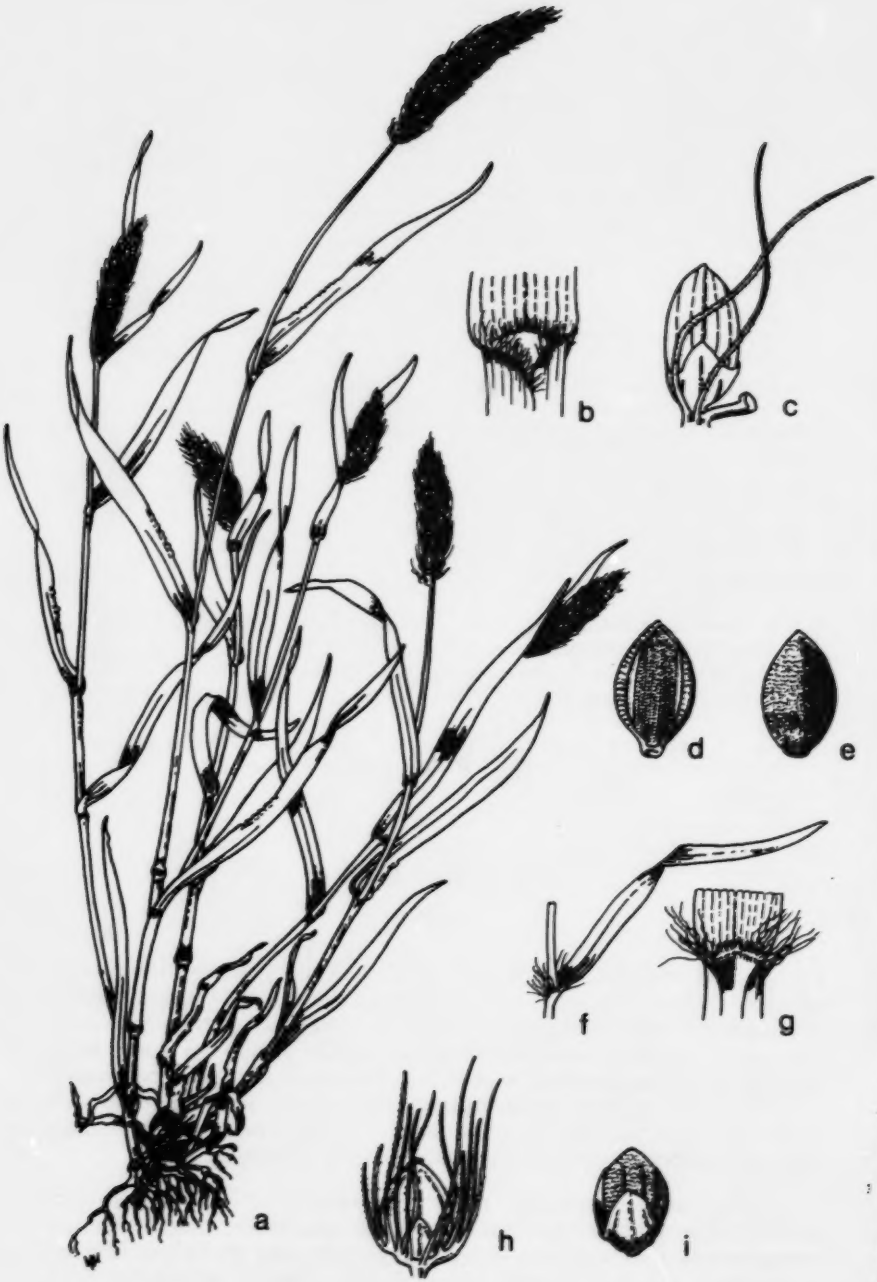
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Fig. 34. *Setaria*. (*a*–*e*) *S. viridis*. (*a*) Whole plant; nodes exposed; culms more or less decumbent at base. Approximately 0.3×. (*b*) Junction of the leaf sheath and the blade; ligule a ciliate fringe of hairs, to 1.5 mm long; blade glabrous. Approximately 2×. (*c*) Spikelet rachis joint, with 2 involucral bristles and lower glume surrounding the base of the sterile lemma. Approximately 10×. (*d*) View of floret; lemma margins overlapping the equally long palea. Approximately 8×. (*e*) View of lemma dorsally compressed; surface glabrous, and with regular rows of cells visible in detail at 40×. Approximately 8×. (*f*–*i*) *S. glauca*. (*f*, *g*) Junction of the leaf sheath and the blade; ligule ciliate, less than 1 mm long; trichomes to 8 mm long occurring on blade margins adjacent to the ligule. (*h*) Spikelet and involucre with numerous bristles. Approximately 5×. (*i*) Spikelet with involucre removed; lower glume and sterile lemma with prominent veins. Approximately 5×.

glabrous; lower glume 0–3-nerved; upper glume 3-nerved. Sterile lemmas similar in texture to the upper glumes, 5–many nerves, usually approximately as long as the fertile lemmas, with or without associated paleas. Fertile lemmas rounded on the back; surface glabrous but lemma cells commonly cross-wrinkled; indurate when caryopsis is mature. Paleas as long as the lemmas and similarly rounded, 2-nerved, colorless, sometimes with cross-wrinkled cells. Lodicules 2, free, fleshy, apically lobed or rounded. Anthers 3, yellow or purple. Ovary apex glabrous; styles free to the base; stigmas yellow or brown. $x = 9$.

Setaria glauca (L.) Beauv., *S. verticillata* (L.) Beauv., *S. viridis* (L.) Beauv.

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Tribe Andropogoneae

47. *Andropogon* L.

Fig. 35

Tufted perennials, often more than 1 m high, with or without rhizomes. Culms stiffly erect, glabrous; nodes exposed; upper culm internodes with continuous spongy parenchyma. Sheaths glabrous or scabrous, keeled, tightly surrounding the culm, open; margins overlapping; ligules membranous, with or without ciliate hairs on the apex and

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Fig. 35. *Andropogon*. (*a*–*c*) *A. gerardii*. (*a*) Whole plant, tufted from a short, stout rhizome; leaves flat, borne mainly on glabrous culms; nodes exposed; inflorescence a panicle of more or less digitately arranged branches. Approximately 0.2×. (*b*) Junction of the sheath and the blade; sheath margins membranous, overlapping at least for half of the internode; ligule membranous with a ciliate–erose apex; blade on abaxial surface and margins with scabrous projections. Approximately 13×. (*c*) Rachis internode and node with 2 spikelets; rachis internode pubescent; *left*: a sessile, hermaphrodite spikelet with a geniculate awn; *right*: a pedicel spikelet, awnless and usually staminate or sometimes sterile. (The structure of the sessile spikelet is similar to that of *Schizachyrium scoparium*, Fig. 36*f*, the pedicellate spikelet is more fully developed than in *S. scoparium*, having glumes that are similar to the sessile floret, and usually a lemma and 3 stamens.) Approximately 5×. (*d*) *A. hallii*. Rachis internode and node with 2 spikelets; internode pubescent with long, yellowish villous hairs on the sides of the flattened rachis. Approximately 5×.

abaxial surface, 1–3 mm long; auricles absent; collars continuous, distinct or indistinct; blades rolled in bud, becoming flat or setaceous, to 0.5 mm wide, usually glaucous; adaxial surface sometimes with a few hairs at the proximal end, elsewhere glabrous; abaxial surface glabrous or scabrous.

Inflorescence an erect, digitate panicle, with 2–several racemes subtended by a flag leaf; rachis flattened on the side adjacent to the spikelet cluster, rounded on the opposite side with long hairs on the margins. Spikelets in pairs, one sessile, with a hermaphrodite floret and a sterile lemma, the other, terminating a hairy pedicel, staminate or sterile. Glumes similar in length but different in shape, the lower glume rounded on the back with 2 keels, 3–8-nerved, the upper glume laterally compressed with a single keel, 1–3-nerved. Callus not distinctly bearded. A delicately membranous structure situated above the lower glume and almost as long, is interpreted as a sterile lemma. Fertile lemmas glabrous or puberulent only at the apex, with a deep apical notch and a single, straight or geniculate awn, 0.5–2.0 cm long. Fertile paleas one-third to two-thirds the fertile lemma length, delicately membranous, colorless, rounded, and hair fringed at the margins. Lodicules 2, free, fleshy, sometimes with apical hairs. Anthers 3, yellow. Ovary apex glabrous; styles free to the base; stigmas pink, purple, or brown. $x = 9, 10$.

Key to western rangeland species

1. Awn geniculate, 12–20 mm long, rachis hairs less than 3.5 mm long ..... ***A. gerardii*** Vitman (Big bluestem)
1. Awn straight, less than 10 mm long, rachis hairs 3.5–5 mm long ..... ***A. hallii*** Hackel (Sand bluestem)

Little bluestem is placed in the genus *Schizachyrium*.

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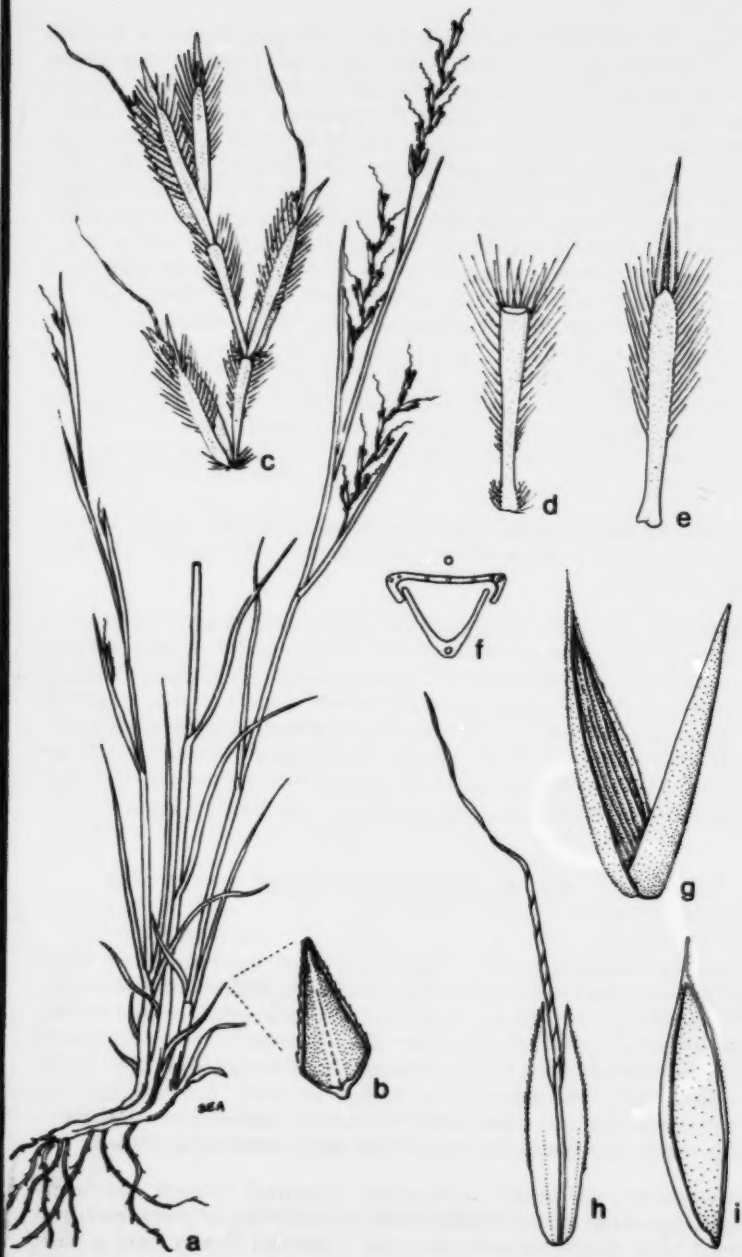
48. *Schizachyrium* Nees.

Fig. 36

Caespitose perennials, usually erect culms 50–150 cm high, sometimes rhizomatous. Culms glabrous; nodes exposed; upper culm internodes with continuous spongy parenchyma. Sheaths glabrous or scabrous, keeled, open; margins not overlapping at maturity; ligules membranous with a terminal fringe of hairs, lacerate, 1–2 mm long; auricles either extensions of the sheath margins or absent; collars indistinct, divided; blades folded in bud at a prominent midvein and often remaining folded; surface usually glaucous, with or without scabrous projections.

Fig. 36. *Schizachyrium scoparium*. (*a*) Whole plant, showing small portion of tufted base with short rhizome; leaf sheath bases from previous season's growth; leaves basal and cauline, setaceous by folding; lower sheaths keeled; *left*: young inflorescence with branched panicle, each branch with a leafy spathe covering a developing single raceme; *right*: mature inflorescence. Approximately 0.3×. (*b*) Leaf blade folded at large, central vein, with many uniform lateral veins and tapering to an acuminate tip; margins with prominent scabrous projections. Approximately 25×. (*c*) Portion of a mature raceme; spikelets in pairs at each node, diverging from rachis; one spikelet sessile, hermaphrodite, surrounded by coriaceous glumes, lemma awned; the other spikelet a remnant topping a prominent pedicel. Approximately 3.5×. (*d*) Rachis internode; rachis flattened on the side adjacent to the sessile spikelet, convex on opposite surface; involucral tuft of short hairs at the lower node; lower third of the internode in var. *scoparium* (as drawn) hairless; rachis hairs occurring on the margins in the upper two-thirds; increasing in length from 1 to 4 mm toward the upper node. Approximately 5.5×. (*e*) Pedicel hairy, with remnant apical spikelet; remnant spikelet with only a reduced lower glume, as drawn. Approximately 5.5×. (*f*) Cross section view of glumes of sessile floret; lower glume adjacent to axis with 7 nerves and 2 marginal keels overlapping the edges of the single, keeled, 1-nerved upper glume. Approximately 15×. (*g*) Glumes tapering to an acute apex and stiffly pubescent on each keel, similar in length but different in shape; *left*: lower glume with 2 marginal keels, 5–7-nerved; *right*: upper glume with a single, central keel. Approximately 10×. (*h*) Lemma deeply apically notched, transparent, and delicate, a spirally twisted, geniculate awn; margins ciliate. Approximately 10×. (*i*) Palea longer than the body of the lemma, transparent, 2 faint veins, margins ciliate. Approximately 10×.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Inflorescence usually a much branched panicle, each branch terminating in a single raceme subtended by a leafy spathe that covers the raceme during development; rachis flattened with long hairs on the margins, disarticulating just below the point of attachment of the spikelets so that a spikelet pair and the distally adjacent rachis internode fall as a unit. Spikelets in pairs, one sessile and hermaphroditic, the other a spikelet remnant at the top of a hairy pedicel; appressed during development, divergent at maturity. Glumes large, coriaceous, the lower 5–7-nerved, concave on the back with 2 marginal, pubescent keels, overlapping the upper glume, this laterally compressed with 1–3 nerves, pubescent on the slightly keeled central nerve. Sterile lemma situated above lower glume, membranous, with long terminal trichomes. Fertile lemma often slightly shorter, hyaline, narrow, hair fringed on the margins, deeply apically notched, with 1 nerve that extends into a single, spirally twisted geniculate awn, and sometimes 2 faint lateral nerves. Paleas absent. Lodicules 2, free, fleshy, apically lobed. Anthers 3, pink or purple. Ovary apex glabrous; styles fused at the base; stigmas red brown. $x = 10$.

A relatively large genus well represented in subtropical and tropical grasslands, but with a single species, *S. scoparium* (Michaux) Nash (little bluestem), in Canada.

Although treated as a section of the genus *Andropogon* by Hitchcock and Chase (1951), *Schizachyrium* has been widely recognized as a separate genus and this is the treatment adopted by Gould (1967) in his revision of the North American *Andropogon*. Only one species occurs in Canada and it has been convenient to consider big bluestem (*Andropogon gerardii*) and little bluestem in the same genus, but the distinctive inflorescence and the reduction of the pedicellate floret to a mere remnant, appear to justify generic recognition.

49. *Sorghastrum* Nash

Tufted perennials, to 2.5 m high, with short, scaly rhizomes. Culm nodes hirsute; upper culm internodes glabrous, hollow. Sheaths open; margins overlapping, hyaline; lower sheaths pubescent; upper sheaths usually glabrous; ligule membranous, with a lacerate, erose, or minutely ciliate apex; sheath auricles prominent, continuous with the ligule; collars indistinct, divided; blades rolled in bud, flat at maturity, 5–10 mm wide, without hairs, with prominent, scabrous projections on the blade margins, scaberulous toward the tips, elsewhere glabrous.

Inflorescence a loosely contracted, terminal panicle. Spikelets, although appearing solitary, considered as occurring in pairs, each pair consisting of a sessile spikelet that has 1 perfect flower and a hairy pedicel with a minute apical structure, interpreted as the rudiments of a

second spikelet. Rachis disarticulating immediately below the hairy involucre subtending each unit of spikelets; rachis extended beyond the terminal spikelets and similar in appearance to the sterile, hairy pedicel. Glumes subequal, large, rounded on the backs, with nerves converging toward each acute apex, the lower glume overlapping the upper usually pubescent, 7–10-nerved, the upper glume glabrous, 5-nerved. A delicately membranous structure with long marginal trichomes situated above the lower glume, is interpreted as a sterile lemma. Fertile lemma membranous, narrow, with an apical notch and 1 nerve that extends into a single, geniculate awn 1–2 cm long. Paleas absent. Lodicules 2, free, fleshy, prominently vascularized. Anthers 3, yellow. Ovary apex glabrous; styles fused at the base; stigmas purple. $x = 10$.

Sorghastrum nutans (L.) Nash. Indian grass. Distribution in western provinces is apparently limited to the tall-grass prairie remnants in Manitoba.

Tribe Eragrosteae

50. *Calamovilfa* (A. Gray) Hackel

Fig. 37

Perennials 1–2 m high, with long, scaly rhizomes. Culms glabrous; nodes not exposed; upper culm internodes solid. Leaves borne predominantly on the erect culms; sheaths glabrous or pubescent, open; margins overlapping, with tufts of hairs on the margins near the collars; ligules a fringe of hairs, to 2 mm long; auricle positions with tufts of hairs; collars usually distinct, undivided, glabrous, pale yellow or purple; blades rolled in bud, flat or involute at maturity, glabrous with small scabrous projections on the leaf margins, sometimes pubescent near the collars.

Inflorescence a more or less contracted panicle. Spikelets laterally compressed, disarticulating above the glumes, 1-flowered, awnless, with a short rachilla present between the glumes and the lemma, not extended beyond the flower. Glumes unequal, slightly keeled at the single nerve, glabrous, the lower glume approximately three-quarters as long as the spikelet, the upper glume as long as the spikelet. Callus hairs approximately 0.7 times the lemma length; lemmas slightly keeled at the single nerve, glabrous. Paleas as long as the lemmas, colorless, glabrous, keeled at the 2 nerves and pleated between them. Lodicules 2, free, fleshy, rounded at the apex. Anthers 3. Ovary wall not fused to the ovule, apex glabrous; styles free to the base; stigmas yellow or brown. $x = 10$.

Calamovilfa longifolia (Hooker) Scribner.

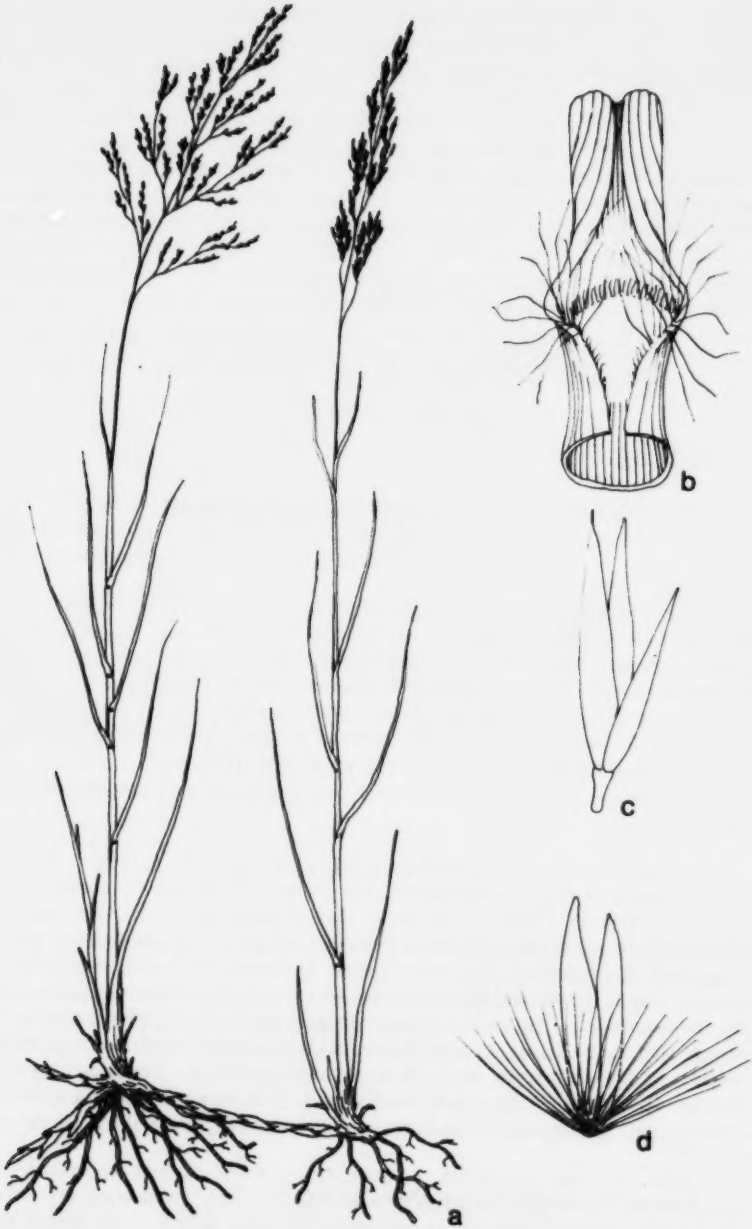
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Fig. 37. *Calamovilfa longifolia*. (*a*) Whole plants with erect culms arising from long, scaly rhizomes; leaves usually setaceous, when flat the glabrous lamina may be up to 1 cm wide. Approximately 0.2×. (*b*) Junction of the leaf sheath and the blade; ligule a fringe of straight hairs usually 1–2 mm long; auricle positions thickened and upper sheath margin with dense tufts of silky hairs. Approximately 3.5×. (*c*) Spikelet; lower glume much smaller than upper glume; lemma slightly shorter than upper glume. Approximately 5×. (*d*) *Left*: lemma and callus with straight hairs half to two-thirds the length of lemma; *right*: palea glabrous, slightly shorter than the lemma. Approximately 6×.

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51. *Eragrostis* Wolf

Annuals (ours), less than 50 cm high, with prostrate stems that may become buried. Culms glabrous; nodes exposed or not; upper culm internodes hollow. Sheaths glabrous or pubescent, open; margins not overlapping, membranous, ciliate, especially near the collars; ligules a fringe of hairs less than 1 mm long; auricles absent; collars divided, glabrous, sometimes indistinct; blades rolled in bud, flat or involute at maturity, less than 0.5 cm wide, abaxial surface glabrous.

Inflorescence an open panicle. Spikelets awnless, laterally compressed, 4–20 florets; rachilla prolonged beyond the uppermost fertile floret; glumes and lemmas deciduous allowing the caryopsis to fall free and leaving paleas on the persistent glabrous rachilla. Glumes subequal, shorter than the lemmas, acute, sometimes mucronate, 1–3-nerved, occasionally glandular or hairy on the slight keel. Lemmas acute, slightly keeled, with 3 nerves that do not converge at the apex. Paleas 0.5–0.8 times the length of the lemmas, green, keeled and pubescent on the outer margins at the 2 nerves. Lodicules 2, free, distally fleshy. Anthers 3. Ovary apex glabrous; styles free to the base; stigmas white. Caryopsis reddish brown and translucent. $x = 10$.

Eragrostis cilianensis (All.) Lutati [*E. megastachya* (Koeler) Link], *E. hypnoides* (Lam.) Britton, E. E. Sterns & Poggenb., *E. minor* Host [*E. poaeoides* Beauv.].

References

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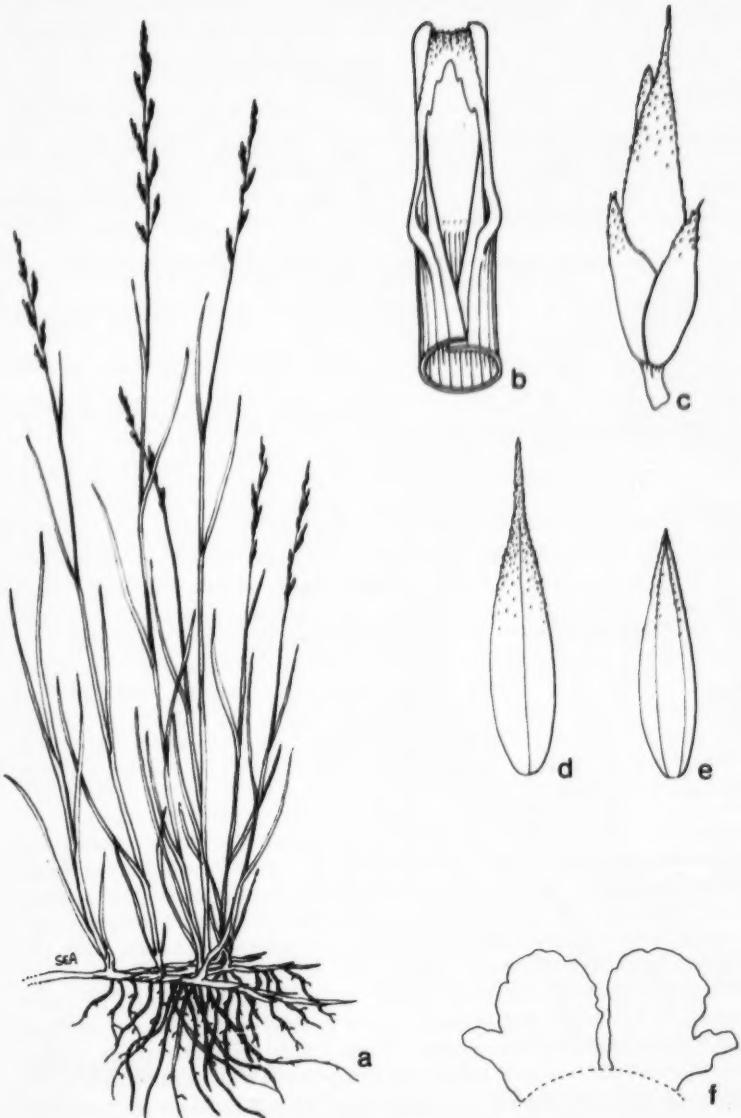
52. *Muhlenbergia* Schreber

Fig. 38

Perennials, to 1 m high, usually less, with or without scaly rhizomes. Culms glabrous or puberulent; nodes usually exposed; internodes solid or hollow. Sheaths glabrous, open; margins overlapping, hyaline, sometimes only at the base of the sheath; ligules membranous, lacerate, sometimes erose–ciliolate, to 3 mm long, often 1 mm or less; auricles absent; collars glabrous, yellow, usually distinct and divided; blades rolled or folded in bud, flat to involute at maturity; surfaces glabrous, scabrous or pubescent.

Inflorescence an open or contracted panicle; spikelets pedicellate, slightly laterally compressed, disarticulating above the glumes, 1-flowered (rarely 2- or 3-flowered); rachilla not prolonged beyond the uppermost floret. Glumes equal or subequal, usually longer than the lemmas (ours), acute, with a slight keel at the single nerve, mucronate or awned. Lemmas with or without a long callus beard, membranous, acute, with 3 nerves converging toward the apex in some species, usually awnless. Paleas approximately as long as the lemmas and similar in texture, laterally compressed, green at the 2 nerves. Lodicules 2, free, fleshy, rarely to 0.3 mm long. Anthers 3, yellow or sometimes purple. Ovary apex glabrous; styles free to the base; stigmas brown or purple. $x = 10$.

Fig. 38. *Muhlenbergia richardsonis*. (*a*) Whole plant; base with hard, mat-forming, scaly rhizomes; leaves nearly flat, basal and cauline; inflorescence a compact, spikelike panicle. Actual size. (*b*) Junction of the leaf sheath and the blade; sheath glabrous, closely appressed to the culm, margins overlapping; ligule membranous, lacerate, strongly decurrent; blade abaxially pubescent with scabrous projections on the margins. Approximately 15×. (*c*) Spikelet; glumes subequal, slightly keeled, much shorter than the lemma; palea almost as long as lemma. Approximately 17×. (*d*) Lemma basally glabrous, puberulent toward the apex; medial vein extending apically as a mucronate tip. Approximately 20×. (*e*) Palea keeled, usually slightly puberulent on the 2 nerves toward the apex. Approximately 20×. (*f*) Lodicules fleshy, each with a single, lateral tooth. Approximately 100×.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Muhlenbergia asperifolia (Nees & Meyen) L. R. Parodi, *M. cuspidata* (Torrey) Rydb., *M. glomerata* (Willd.) Trin., *M. mexicana* (L.) Trin., *M. racemosa* (Michaux) Britton, E. E. Sterns & Poggenb., *M. richardsonis* (Trin.) Rydb.

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53. *Munroa* Torrey

Tufted annuals, less than 30 cm high, with spreading, many branched culms rooting at the nodes and forming mats up to 50 cm in diameter. Culms glabrous, scabrous, or pubescent; nodes not exposed; upper culm internodes spongy or hollow. Sheaths ciliate near the collar, glabrous toward the base of the internode, open; margins not overlapping, hyaline; ligules a fringe of hairs less than 1 mm long; auricle positions with tufts of longer hairs; collars indistinct, divided, pale cream; blades folded in bud, flat or folded, to 2 mm wide; margins and surfaces scabrous.

Inflorescence a reduced panicle of small subsessile clusters of spikelets in tufts of leaves at the ends of culm branches. Spikelets 2–4-flowered, laterally compressed, disarticulating above the glumes and between the florets; rachilla glabrous, prolonged beyond the uppermost fertile floret. Glumes subequal or unequal, shorter than the lowermost lemmas, the lower glume flat or keeled, 0–1-nerved, the upper glume larger, narrow, keeled at the single nerve. Lemmas prominently 3-nerved, the central nerve extended as a short, straight awn or merely mucronate; lemmas of the lower spikelets larger, with a tuft of hairs on the margins about the midpoint. Paleas almost as long as the lemmas, narrow, green, keeled and pubescent on the outer surface at the 2 nerves. Lodicules absent or minute, 0.1–0.2 mm high, free, fleshy. Anthers 3, yellow. Ovary apex glabrous; styles free to the base; stigmas white. Caryopsis dorsoventrally compressed, translucent. $x = 7, 8$.

Munroa squarrosa (Nutt.) Torrey. Apparently introduced to Canada from the United States, this species has been recorded in Alberta several times since 1879. It was recorded from Saskatchewan for the first time in 1948 (Tisdale and Budd 1948).

Reference

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54. *Sporobolus* R. Br.

Fig. 39

Tufted annuals and perennials, less than 70 cm high, without rhizomes. Culms glabrous; nodes exposed or not; upper culm internodes spongy. Leaves basal and cauline, sheaths glabrous, open; margins not overlapping, hyaline, glabrous, scabrous, or pubescent; ligules a fringe of hairs or a short fringed membrane less than 0.8 mm long; auricle positions with tufts of hairs; collars usually distinct, pale yellow, with marginal or continuous hairs; blades rolled in bud, flat or setaceous at maturity; adaxial surface variable, abaxial surface glabrous; margins with scabrous projections.

Inflorescence an open or contracted panicle often surrounded by the leaf blade until late in development. Spikelets tending to be laterally compressed, disarticulating above the glumes but with the glumes usually soon falling, 1-flowered, awnless; rachilla not prolonged beyond the floret. Glumes narrow, subequal or unequal, 1-nerved, the upper glume sometimes almost as long as the lemma. Callus not bearded. Lemmas acute, 1-nerved, membranous, glabrous. Paleas almost as long as lemmas, membranous, colorless, rounded on the back, readily splitting between the 2 nerves allowing the mature seed to drop. Lodicules 2, free, fleshy, usually at least as wide as high. Anthers 3, yellow or pink. Ovary wall not fused to the ovule; ovary apex glabrous; styles free to the base; stigmas white. $x = 6, 7$.

Sporobolus airoides (Torrey) Torrey, *S. asper* (Michaux) Kunth, *S. cryptandrus* (Torrey) A. Gray, *S. heterolepis* (A. Gray) A. Gray, *S. neglectus* Nash.

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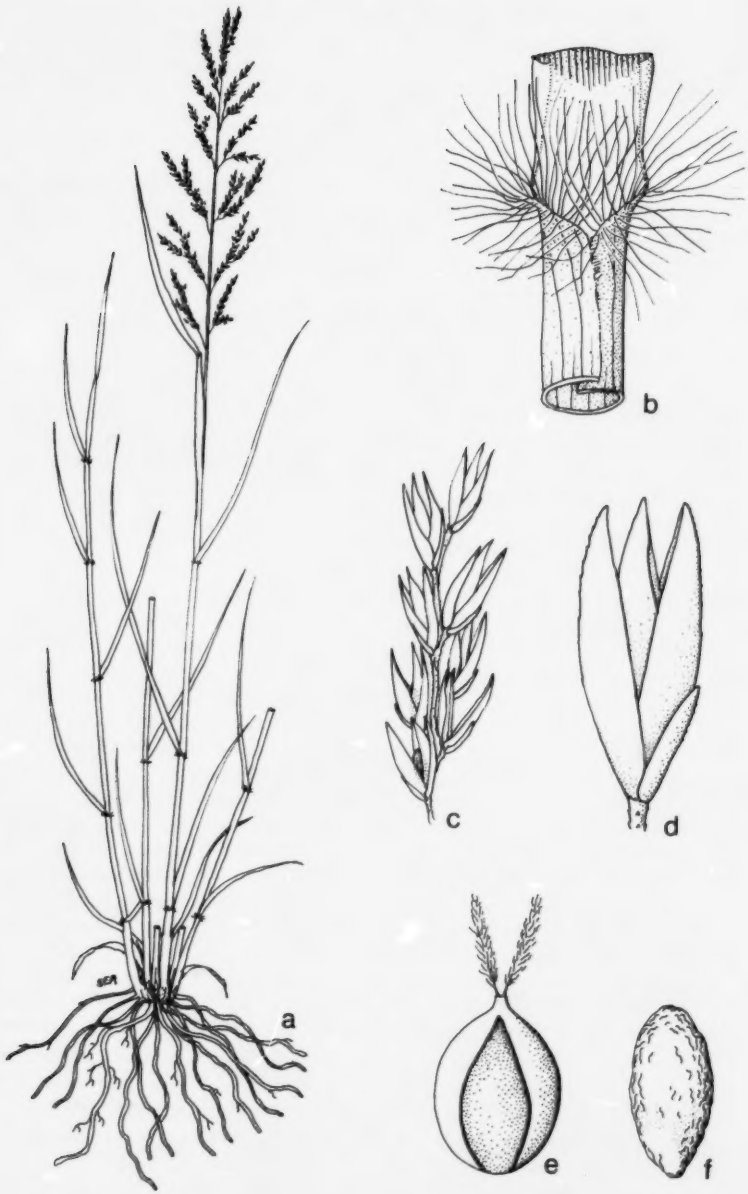
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Fig. 39. *Sporobolus cryptandrus*. (*a*) Whole plant; base tufted with persistent leaf sheaths from previous season's growth; leaves both basal and cauline, flat, sometimes setaceous, narrow; collar and auricle positions with conspicuous tufts of hairs; inflorescence an open panicle. Approximately 0.3×. (*b*) Junction of the leaf sheath and the blade; auricle positions with tufts of long hairs, sometimes extending around collar and down sheath margins, and in this view, obscuring the ligule that is a fringe of hairs less than 1 mm long. Approximately 10×. (*c*) Rachis branch; spikelets borne on short pedicels, upper glume adjacent to rachis; lowest spikelet mature, with lemma and palea open allowing seed to drop. Approximately 5.5×. (*d*) Single-flowered spikelet; glumes unequal, each with slightly scaberulous keel; lemma similar to upper glume; palea as long as lemma. Approximately 20×. (*e*) Gynoecium glabrous; wall splitting longitudinally, releasing the ovule that is completely free from the ovary wall. Approximately 13×. (*f*) Seed separated from ovary wall; not a caryopsis as in most grasses. Approximately 25×.

Tribe Chlorideae

55. *Bouteloua* Lag.

Fig. 40

Perennials, less than 80 cm high, with or without rhizomes. Culms glabrous; nodes exposed; upper culm internodes spongy. Sheaths glabrous or pubescent, open, closely appressed to the culm; margins overlapping; ligules a fringe of hairs, to 1 mm long; auricle positions sometimes with a tuft of scattered longer hairs; collars distinct or indistinct, usually continuous; blades rolled in bud, flat or setaceous; less than 0.5 cm wide; upper surface scabrous or pubescent, lower surface variable; margins usually scabrous or scaberulous.

Inflorescence spicate, composed of short branches with 2−several spikelets in 2 rows alternating along the margins of a flattened, 3-angled rachis; disarticulating above the glumes, *B. gracilis*, or by the breaking up of the rachis, *B. curtipendula*. Spikelets with 1 sessile and hermaphrodite floret, and above this 1(−2) pedicellate, staminate, or rudimentary florets. Glumes 1-nerved, acuminate or awn-tipped, the lower glume about one-third the size of the upper glume that is as long as the spikelet. Callus bearded, *B. gracilis*, or not, *B. curtipendula*. Lemmas membranous, rounded, and pubescent on the back, with 3 nerves that extend as mucros or short awns. Paleas almost as long as lemmas, colorless or pink, concave on the outer surface between the 2 nerves. Lodicules 2, free, fleshy, with a single, pointed projection on the outer margins. Anthers 3, yellow or purple. Ovary apex glabrous; styles free to the base; stigmas white. $x = 10$.

Bouteloua curtipendula (Michaux) Torrey, *B. gracilis* (Humb., Bonpl. & Kunth) Lag. ex Steudel.

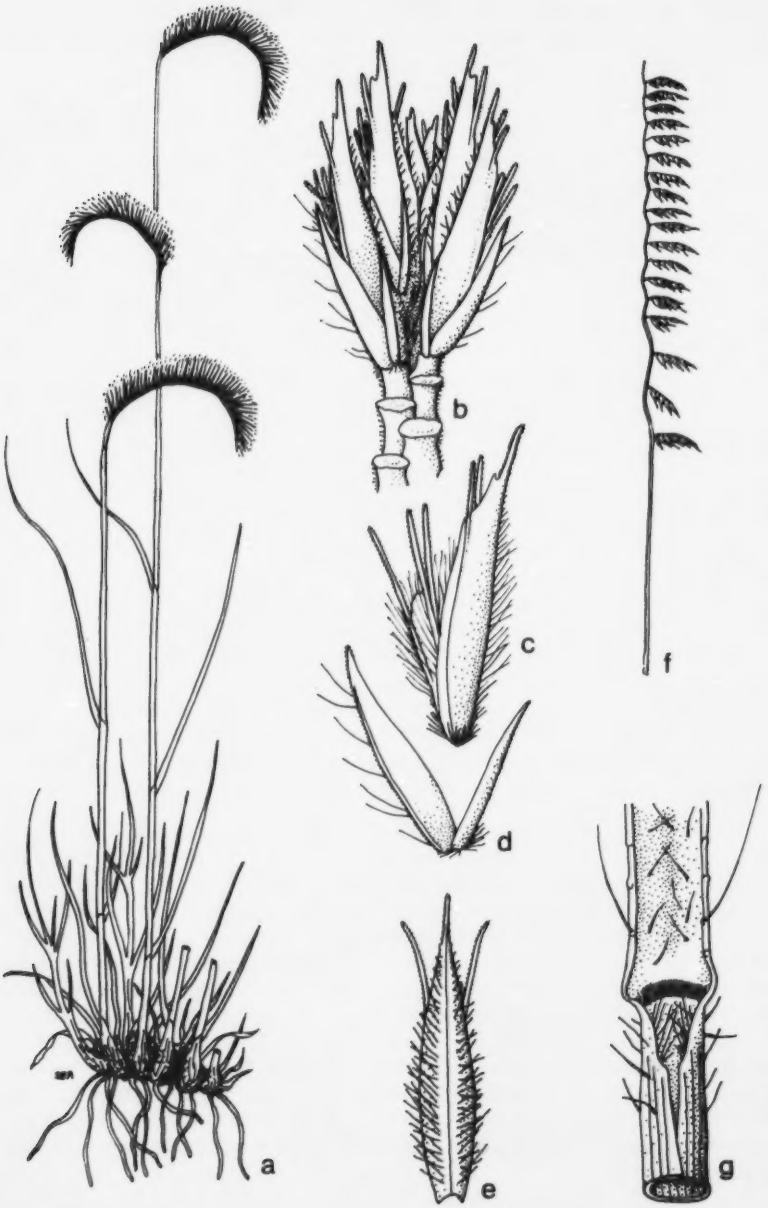
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Fig. 40. *Bouteloua*. (*a*–*d*) *B. gracilis*. (*a*) Whole plant, tufted; leaves both basal and cauline, usually setaceous; inflorescence spicate; spikelets secund. Approximately 0.7×. (*b*) Terminal portion of rachis, flattened; margins pubescent; pedicels short, arranged in two alternate rows; spikelets orientating with lower, smaller glume toward center of the inflorescence. Approximately 10×. (*c*, *d*) Dissected spikelet. (*d*) Glumes unequal, keeled, 1-nerved; lower glume puberulent, upper glume puberulent and with longer, stiffer trichomes; (*c*) Spikelet without glumes; *right*: a sessile fertile floret; lemma with 3 short awns; *left*: a hairy pedicel (not visible) bearing a reduced floret with 3 long awns (as drawn). Approximately 10×. (*e*) Dorsal view of lemma, rounded and pubescent on back, with 3 nerves that extend into short awns. Approximately 10×. (*f*, *g*) *B. curtipendula*. (*f*) Inflorescence, spicate; rachis erect, with short, secund, lateral branches, and bearing 2–6(10) secund spikelets, alternately arranged in two rows. Actual size. (*g*) Junction of the sheath and the blade; sheath with scattered, ciliate hairs; sheath margins glabrous, overlapping; ligule a fringe of hairs; auricles absent; adaxial blade surface and margins with long trichomes that have swollen bases. Approximately 7×.

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56. *Buchloë* Engelmann

A monotypic genus, perennial, 1–15(–30) cm high, with long stolons and tufted leaves. Nodes not exposed; stolon internodes glabrous, spongy. Sheaths glabrous, open; margins overlapping, hyaline; ligules a fringe of hairs 1.5–3 mm long; collars indistinct, divided, cream; blades rolled in bud, flat, 1–2 mm wide; surfaces pubescent or glabrous; margins with scabrous projections.

Inflorescences staminate or pistillate, usually on separate plants but occasionally on the same plant; staminate spikelets exserted above the culm leaves, 2-flowered, sessile, secund on a flattened rachis; pistillate spikelets in clusters of 2–4 among leaves, usually partially included in expanded leafy sheaths, deciduous from the rachis and falling in a burrlike cluster, not conspicuously compressed, 1-flowered. Glumes unequal, the lower membranous, mucronate, 1-nerved, well developed, reduced or absent, the upper glume leafy, rounded on the back,

expanded, fleshy, becoming indurate, 3–6-nerved, mucronate at the apex. Lemmas rounded on the back, glabrous, colorless, except at the 3 nerves that extend as green, mucronate points. Paleas as long as the lemmas, glabrous, membranous, colorless, keeled at the 2 nerves. Lodicules 2, free, apically fleshy or membranous, toothed or lobed, glabrous or with a few stiff trichomes. Anthers 3. Ovary apex glabrous; styles free to the base; stigmas brown. $x = 10$.

Buchloë dactyloides (Nutt.) Engelmann. Found in the short-grass prairie of southeastern Saskatchewan and southwestern Manitoba. It is considered rare in Canada (Maher et al. 1979, White and Johnson 1980).

57. *Schedonnardus* Steudel

Fig. 41

Tufted perennials, to 40 cm high. Culms erect or decumbent, strongly angled and puberulent; nodes rarely exposed; upper culm internodes spongy or hollow. Leaves mostly basal; sheaths keeled and scaberulous at the midvein, elsewhere glabrous, open to the base; margins overlapping, hyaline; ligules membranous, entire or lacerate, not ciliate, 2–3 mm long, extending into the auricle positions and along the blade and sheath margins for a short distance; collars indistinct, divided, glabrous, cream; blades folded in bud, short, at maturity flat, or remaining folded and appearing setaceous; margins and the abaxial midrib scabrous, elsewhere glabrous.

Fig. 41. *Schedonnardus paniculatus*. (*a*) Whole plant, densely tufted, with leaf sheaths from previous season's growth; leaves mostly basal, both flat and setaceous, remaining folded as at vernation; inflorescence a panicle of undivided, stiff, spicate branches. Approximately 0.6×. (*b*) Junction of the leaf sheath and the blade; sheath keeled, often scaberulous on keel, elsewhere glabrous; ligule membranous, usually entire, 2–3 mm long, decurrent with hyaline sheath margins; blade with prominent midvein, glabrous except for scabrous projections on the margins. Approximately 6.5×. (*c*) Rachis branch; spikelets secund and alternate along the triangularly flattened rachis branch that has short, stiff hairs on the angles; laterally compressed spikelets are appressed to the rachis and pubescent on the glume keels. Approximately 6.5×. (*d*) Single-flowered spikelet; glumes subequal, keeled, colored and pubescent at the single nerve; margins membranous; upper glume sometimes almost as long as lemma. Approximately 10×. (*e*) Mature floret; palea almost as long as lemma; lemma and palea rounded and pubescent on outer surfaces. Approximately 10×.

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Inflorescence a panicle one-half to three-quarters the height of the plant, with alternate, undivided, stiff, spicate branches bearing widely spaced spikelets more or less embedded in the flattened, 3-angled, pubescent rachis. Spikelets laterally compressed, disarticulating above the glumes, 1-flowered; rachilla not prolonged. Glumes subequal or unequal, narrow, membranous, and colorless except at the single nerve that is keeled and stiffly pubescent. Lemmas acute, membranous, 3-nerved, rounded, and stiffly pubescent on the back. Paleas almost as long as the lemmas, 2-nerved, keeled in bud, becoming rounded on the back at maturity. Lodicules 2, free, fleshy, apically rounded. Anthers 3, yellow. Ovary apex glabrous; styles free to the base; stigmas white. $x = 10$.

Schedonnàrdus paniculatus (Nutt.) Trel. Tumblegrass. After flowering, the inflorescence axis is reported to elongate to 30–60 cm and become curved in a loose spiral, later breaking away at the base and being blown about by the wind as a tumbleweed (Hitchcock and Chase 1951).

58. *Spartina* Schreber

Fig. 42

Perennials 0.6–2.0 m high, with well-developed rhizomes. Culms glabrous; nodes rarely exposed; upper culm internodes hollow. Sheaths glabrous, sometimes keeled toward the ligule, open; margins overlapping; ligules a ciliate fringe of hairs, 1–3 mm long; collars distinct, divided or continuous, glabrous; blades rolled in bud, flat or becoming involute, hairless; adaxial surface and margins with scabrous projections, abaxial surface glabrous.

Fig. 42. *Spartina*. (*a*–*f*) *S. gracilis*. (*a*) Whole plant spreading by long rhizomes with scalelike leaves; leaves flat, mostly cauline. Approximately 0.3×. (*b*) Inflorescence a spike of secund, spicoid branches. Approximately 1.6×. (*c*) Adaxial surface at junction of the leaf sheath and the blade; sheath margin with a few small hairs on upper portion, elsewhere sheath glabrous; ligule a ciliate fringe; blade veins prominent, more or less uniform, with scaberulous projections; blade margins inrolled as leaf dried. Approximately 6×. (*d*) Abaxial surface of sheath and blade at undivided collar, with a swelling at the collar that is pale yellow, distinct from green leaf sheath and blade. Approximately 6×. (*e*) Rachis and 2 spikelets at apex of an inflorescence branch, lower spikelets removed to show that they attached alternately on a flattened, ridged rachis that is stiffly ciliate on the margins; lower, shorter glume and lemma toward rachis; upper glume and palea that is longer than lemma, toward the outside. Approximately 2.5×. (*f*) Spikelet; glumes unequal, keeled and stiffly ciliate at the single nerve; apex acute but without a mucron or awn. Approximately 4×. (*g*) *S. pectinata*. Spikelet; glumes unequal, keeled, stiffly ciliate at the single nerve, upper glumes tapering to a short awn; lemma adjacent to lower glumes, 1-nerved, ciliate on keel. Approximately 4×.

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Inflorescence a panicle with spicate branches of sessile, secund spikelets in 2 rows alternating along the margins of a 3-angled, flattened rachis; rachis bare-tipped. Spikelets strongly laterally compressed, disarticulating below the glumes, 1-flowered; rachilla not prolonged. Glumes unequal, narrow, keeled and scabrous or ciliate at the single nerve, the upper glume with or without a short awn. Lemmas membranous, colorless except at the keel, with 1 strong central nerve, 2 lateral nerves obscure when present. Paleas as long as or longer than the lemmas, glabrous, strongly laterally compressed, pleated between the 2 faint nerves. Lodicules, when present, 2, free, fleshy. Anthers 3, yellow. Ovary apex glabrous; styles fused at the base; stigmas golden brown. $x = 7, 10$.

Key to western rangeland species

1. Blades usually more than 5 mm wide; upper glume with an awn as much as 7 mm long ..... ***S. pectinata*** Link
1. Blades usually less than 5 mm wide; upper glume awnless . ***S. gracilis*** Trin.

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Tribe Aeluropodeae

59. *Distichlis* Raf.

Fig. 43

Dioecious (rarely monoecious) perennials, less than 50 cm high, with rhizomes. Culm nodes glabrous, internodes spongy or hollow. Leaves distichous, closely overlapping; sheaths glabrous, open; margins overlapping, sometimes scabrous; ligules membranous at the base with a terminal fringe of hairs 0.5–1 mm long; auricle positions with tufts of longer hairs; collars distinct, continuous, pale yellow; blades stiff, flat or remaining folded and appearing setaceous, to 4 mm wide with scattered hairs toward the ligule, often scabrous toward the blade apex.

Inflorescence a contracted panicle with relatively few flowers; rachis flattened with scabrous projections on the margins. Spikelets awnless, distichously arranged, laterally compressed; pistillate spikelets thicker than the staminate spikelets, disarticulating above the glumes and between the 3–many florets; rachilla glabrous, prolonged beyond the uppermost fertile floret. Glumes subequal or unequal, rounded on the

back, glabrous, the lower glume 1–5-nerved, the upper glume 4–8-nerved. Lemmas slightly longer than the upper glumes, acute, rounded on the back, glabrous, with 7–11 nerves that converge toward the apex. Paleas approximately the length of the lemmas, colored, keeled and puberulent at the 2 nerves, concave on the outer surface between the nerves. Lodicules 2, free, fleshy, apically lobed, present in both pistillate and staminate florets. Anthers 3, rudiments present in pistillate florets. Ovary apex glabrous; styles fused near the base; stigmas golden brown or purple. $x = 10$.

Distichlis spicata (L.) Greene var. *stricta* (Torrey) Scribner.

Scoggan (1978) recognized two species in this genus in Canada, claiming *D. spicata* (L.) Greene occurs only in coastal salt marshes and *D. stricta* (Torrey) Rydb. occurs on interior wet alkaline flats and in coastal salt marshes. Beetle (1943) after a detailed study of characters used to distinguish the species, concluded that *D. stricta* is not specifically distinct from *D. spicata*. Cronquist et al. (1977) found that the interior or desert saltgrass differs from the seashore variety by having longer hairs in the vicinity of the leaf collars, looser panicles, and broader keel wings on the pistillate paleas. The taxon *D. dentata* was suggested by C. L. Hitchcock for those plants occurring mainly west of the Rocky Mountains, whereas typical *D. stricta*, as defined, occurred mainly east of the Rocky Mountains. Cronquist et al. (1977) found the distinction so weak that they dropped the name *D. dentata* even at the varietal level.

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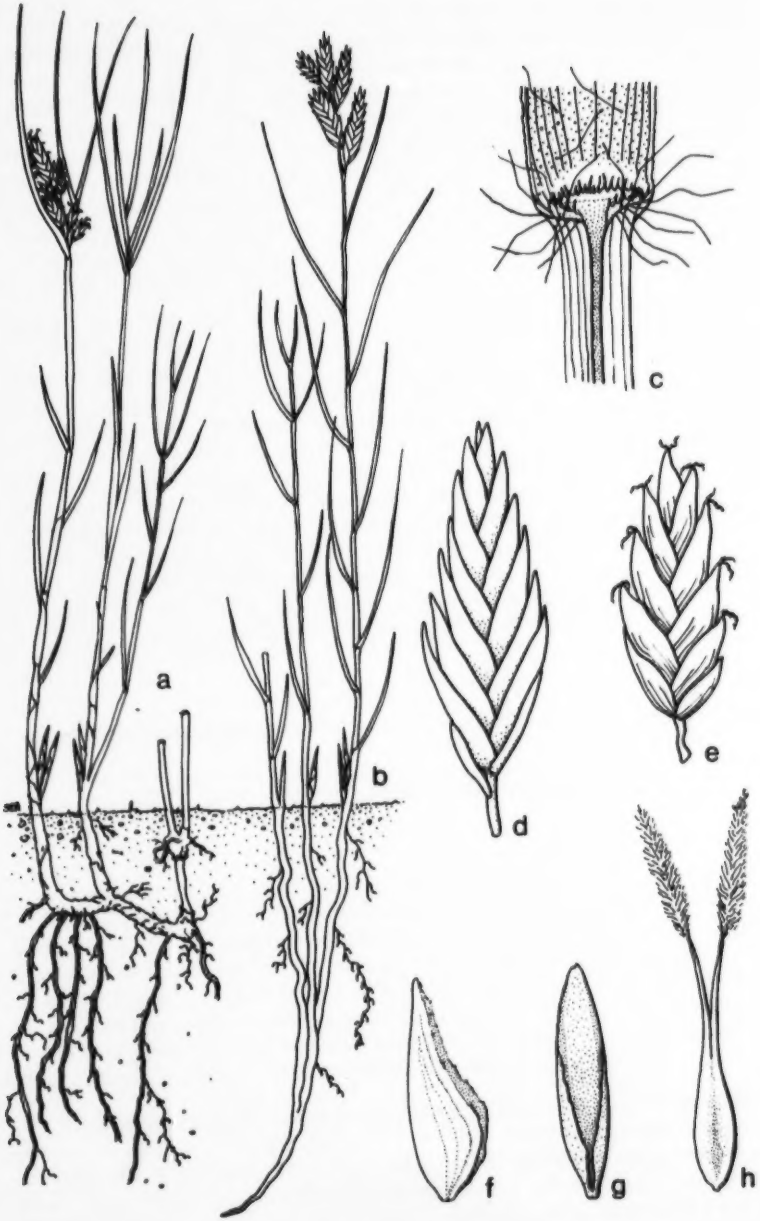
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Fig. 43. *Distichlis spicata.* (*a*) Whole plant that was growing in alkaline marshy conditions; rhizome well developed, spreading horizontally; lower culm leaves sparse and poorly developed; upper leaves distichous; inflorescence a contracted, spikelike panicle with pistillate flowers. Actual size. (*b*) Whole plant that was growing in meadow habitat; base of plant compact, ascending rather than spreading rhizomes; culm leaves well developed at base of the plant; inflorescence of many-flowered staminate spikelets. Actual size. (The difference in the base of the plants in (*a*) and (*b*) is attributed to the different habitats in which they were growing, not to dioecious characters.) (*c*) Junction of the leaf sheath and the blade; sheath open, glabrous; ligule membranous at the base, apically fringed with hairs, auricle position and adaxial surface of blade with a few long, silky hairs; blade margins with minute scaberulous projections. Approximately 10×. (*d*) Male spikelet; glumes subequal, glabrous; as drawn, 11 florets and a terminal, remnant floret. Approximately 2.5×. (*e*) Female spikelet; as drawn, 8 florets, stigmas protruding. Approximately 2.5×. (The number of florets per spikelet varies, but the female spikelet is shorter and broader than the male spikelet.) (*f*) Lemma from female spikelet, broad at base, with 7 nerves converging toward the acute apex. Approximately 8×. (*g*) Palea from female floret concave on outer surface between the 2 strongly keeled nerves; margins surrounding gynoecium; the degree of pubescence on keels varies and has been used by some authors to distinguish species. Approximately 8×. (*h*) Gynoecium; ovary glabrous, styles fused at the base. Approximately 9×.

Tribe Aristideae

60. *Aristida* L.

Tufted perennials (ours), 30–60 cm high. Culms glabrous or scaberulous; nodes not exposed; upper culm internodes spongy. Sheaths open; margins overlapping, hyaline, glabrous, elsewhere sheath scabrous or scaberulous; ligules a short membrane fringed with hairs about 0.5 mm long; auricle positions with tufts of longer hairs; collars indistinct, pale green; blades involute in bud and usually remaining rolled and appearing setaceous; upper lamina surface densely pubescent; lower surface glabrous to scabrous; margins with minute scabrous projections.

Inflorescence a contracted panicle dominated by long, trifid, geniculate awns from each lemma. Spikelets not strongly compressed, disarticulating above the glumes, 1-flowered; rachilla not prolonged. Glumes unequal, scaberulous, 1-nerved, rounded proximally, keeled apically for about half the length. Callus bearded. Lemmas 3-nerved, dorsally rounded, indurate, narrowing at the apex to an awn column bearing 3, usually stiff, awns. Paleas much shorter than lemmas, colorless, rounded, sometimes with 2 faint nerves. Lodicules 2, free, as long as the palea or slightly longer, fleshy and highly vascularized. Anthers 3. Ovary apex glabrous; styles fused near the base; stigmas yellow. $x = 11$.

Aristida purpurea Nutt. [*A. longiseta* Steudel]. Red three-awn. This is an uncommon grass occurring in dry prairies of British Columbia, Alberta, and Saskatchewan.

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Tribe Oryzeae

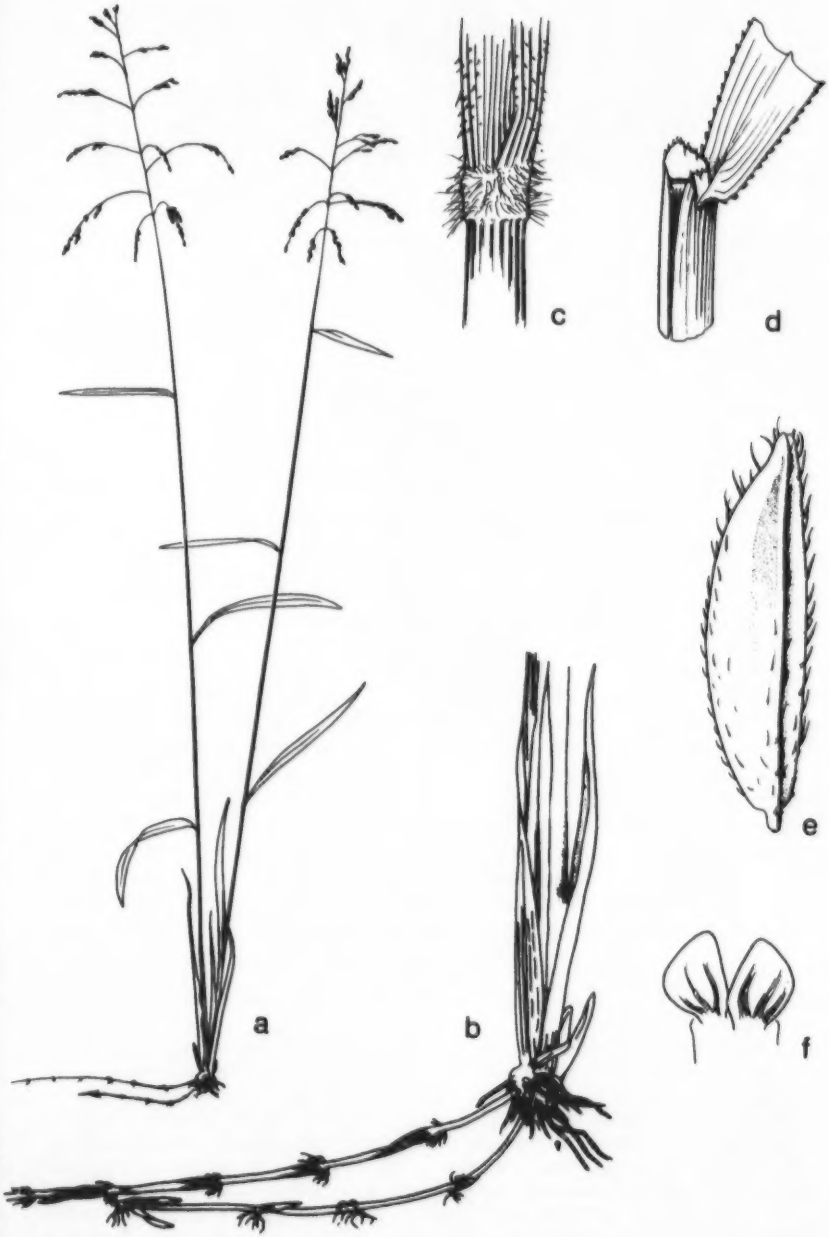
61. *Leersia* Swartz

Fig. 44

Rhizomatous perennials of wet habitats, 1–1.5 m high. Culm internodes glabrous, hollow; nodes exposed, pubescent. Sheaths scabrous, open; margins overlapping, not hyaline, sometimes a few scabrous hairs; ligules membranous, entire, 1–2 mm long; auricles absent; collars distinct, divided, glabrous, pale yellow; blades rolled in bud, flat, hairless; upper surface minutely scabrous; margins prominently scabrous.

Inflorescence a loose panicle. Axillary panicles bear cleistogamous flowers toward the end of the season, not exerted from the leaf sheaths. Spikelets laterally compressed, disarticulating from the pedicel as a unit, 1-flowered, awnless. Glumes absent. Lemmas broad, keeled, with prominent, scabrous projections on the outer surface and 5 nerves that converge at the apex, 2 of the nerves submarginal. Paleas as long as lemmas, narrower, covered with scabrous projections, colored, 3-nerved, keeled at the central nerve, membranous at the margins.

Fig. 44. *Leersia oryzoides*. (*a*) Whole plant, with long, spreading rhizomes; leaves basal and cauline; inflorescence an open panicle. Approximately 0.2×. (*b*) Base of plant showing long rhizomes with roots and leaves arising at nodes. Actual size. (*c*) Culm with exposed pubescent node. Approximately 7×. (*d*) Junction of the leaf sheath and the blade; ligule a short, firm membrane, decurrent with sheath margins. Approximately 7×. (*e*) Floret; glumes absent; *left*: lemma; *right*: palea, as long as the lemma and with prominent scabrous projections on outer surface. Approximately 25×. (*f*) Lodicules fleshy, highly vascularized. Approximately 65×.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Lodicules 2, free, fleshy. Anthers 1–6, ours 3. Ovary apex glabrous; styles free to the base; stigmas white. $x = 12$.

Leersia oryzoides (L.) Swartz. Rice cutgrass. Found in permanently wet areas, usually beside lakes or rivers. Recorded for Manitoba, Saskatchewan, and British Columbia. We are unaware of any Alberta records.

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62. *Zizania* L.

Fig. 45

Aquatic annuals, usually more than 1 m high, without rhizomes. Culm internodes glabrous, hollow; nodes exposed, puberulent. Sheaths glabrous, open; margins overlapping, usually hyaline; ligules membranous, lacerate, 3–11 mm long; auricles absent; collars distinct, continuous or divided, pale yellow or purple; blades rolled in bud, becoming flat, usually more than 1 cm wide, glabrous; margins scabrous.

Inflorescence a loose panicle with pendulous staminate spikelets below and appressed pistillate spikelets above. Spikelets unisexual, not noticeably compressed, disarticulating from the pedicel below the glumes that are reduced and represented by a collarlike ridge of tissue. Staminate lemmas, membranous, keeled, with scabrous prickles on the outer surface of the 5 nerves, 2 of these marginal; mucronate, or with a short awn, often purple. Staminate paleas, as long as lemmas, membranous, colorless, keeled at the 2 nerves. Pistillate lemma pale green or yellow, scabrous on the margins and 5 nerves, keeled at the 2 medial nerves and enfolding the palea, the central nerve extending as a long, straight awn; lemma and palea becoming indurate around grain.

Fig. 45. *Zizania palustris*. (*a*) Plant annual, without rhizomes; leaves borne on culms; blades flat. Approximately 0.16×. (*b*) Inner wall of leaf sheath with conspicuous horizontal veins between lateral veins. Approximately 5×. (*c*) Junction of the sheath and the blade; ligules membranous, lacerate. Approximately 3×. (*d*) Staminate floret with 6 stamens; glumes absent; *right:* lemma; *left:* palea as long as lemma. Approximately 7×. (*e*) Side view of pistillate lemma (awn shortened); margins with scabrous projections toward the apex. (The keeling of lemma at 2 medial nerves so that lemma surrounds the palea firmly, is not visible in this view.) Approximately 5×. (*f*) Pistillate palea as long as lemma, keeled at the 2 nerves, scabrous between the nerves at the apex. Approximately 5×.

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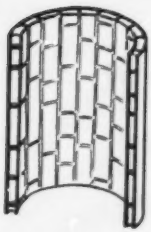
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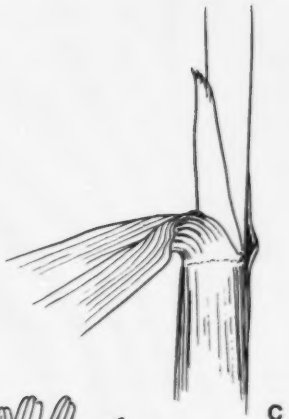
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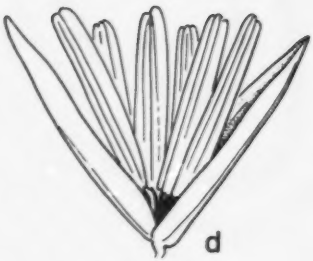
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Lodicules 2, free, fleshy, slightly larger in pistillate florets. Anthers 6. Ovary apex glabrous; styles free to the base; stigmas white. $x = 15$.

Zizania palustris L. [*Z. aquatica* L. *pro parte*]. *Zizania aquatica* sensu *stricto* is restricted in Canada to southern Ontario (Dore 1969). *Zizania palustris* occurs in shallow-water lakes and slow rivers in Manitoba and it has been introduced into Saskatchewan.

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Tribe Arundineae

63. *Phragmites* Adanson

Robust perennials, 2–5 m high, forming large stands from rhizomes (rarely stolons) up to 10 m long. Culms glabrous; nodes exposed; upper culm internodes hollow. Sheaths glabrous, open; margins overlapping toward the base of the internodes, hyaline; ligules a fringe of hairs, to 1.5 mm long; auricles absent; collars distinct, continuous, glabrous, pale yellow, often brown at the margins; blades rolled in bud, flat, laminas 1–5 cm wide, glabrous on both surfaces and margins, blades ultimately disarticulating from the sheaths at the collars.

Inflorescence a plumose panicle; spikelets opening to expose long, villous hairs on the rachilla that give the inflorescence a fluffy appearance. Spikelets awnless, disarticulating above the glumes and between the 1–6 florets, the lower floret sterile or staminate, with only 1(2) stamens, the upper florets with 3 stamens; rachilla extended beyond the uppermost floret. Glumes unequal, acute, membranous, glabrous, with 1–3(5) veins that converge at the acute apices. Lemmas rounded on the back, glabrous, with 3–5 nerves that converge toward the long, acuminate apex. Paleas 0.2–0.3 times the lemma length, colorless, keeled and pubescent on the 2 nerves. Lodicules 2, free, fleshy. Ovary apex glabrous; styles free to the base; stigmas yellow. $x = 12$.

Phragmites australis (Cav.) Trin. ex Steudel [*P. communis* Trin.]. Voss (1966), Clayton (1968), and McNeill and Dore (1977) discuss the name change.

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Tribe Danthonieae

64. *Danthonia* Lam. & DC.

Fig. 46

Tufted perennials, less than 1 m high, without rhizomes. Culms glabrous, nodes exposed, sometimes constricted; upper culm internodes hollow. Sheaths pubescent or glabrous, open; margins overlapping, hyaline, ligules a fringe of hairs less than 1 mm long; auricle positions with a tuft of hairs 2–4 mm long; collars continuous, pale yellow, distinct or indistinct, sometimes pubescent; blades folded in bud, remaining folded and setaceous or flat, to 4 mm wide.

Inflorescence sometimes with cleistogamous spikelets in lower culm sheaths. Chasmogamous spikelets laterally compressed, disarticulating above the glumes and between the 5–10 florets; rachilla prolonged beyond the uppermost fertile floret. Glumes subequal, broad, longer than the lemmas, glabrous, awnless, sometimes slightly keeled, indistinctly 3–7-nerved. Lemmas rounded on the back with a basal hairy callus, with or without other pubescence, 3–11 converging nerves, the central nerve extended into a geniculate awn, the lateral nerves converging in 2 teeth that extend as acuminate points, or short awns. Paleas almost as long as the lemmas, colored, keeled and pubescent or puberulent on the outer margins at the 2 nerves. Lodicules 2, sometimes absent, free, fleshy, apically lobed or unlobed. Anthers 3. Ovary apex glabrous; styles free to the base; stigmas white. $x = 6$.

Danthonia californica Bolander, *D. intermedia* Vasey, *D. parryi* Scribner, *D. spicata* (L.) Beauv., *D. unispicata* (Thurber) Munro. These species are the ones recognized by Boivin (1981) and Looman and Best (1979) rather than those of Baum and Findlay (1973).

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Fig. 46. *Danthonia parryi*. (*a*) Whole plant, densely tufted with leaf bases persisting from previous season's growth; leaves mostly basal, narrow, either flat or setaceous; inflorescence a loose panicle. Approximately 0.4×. (*b*) Spikelet; lower glume slightly longer than upper glume, both exceeding the 4–7 florets in length; glumes dorsally rounded, tapering to acute tip, with a papery texture; lemma awns, geniculate, spirally twisted, protruding between the glumes. Approximately 2×. (*c*) Junction of the leaf sheath and the blade; sheath glabrous, with margins overlapping and membranous; ligule a ciliate fringe of hairs 1–2 mm long; auricle position with tufts of longer hairs; adaxial blade surface adjacent to ligule with many short hairs and scattered longer hairs that become more sparse away from the ligule region. Approximately 7×. (*d*) Lemma with distinct tuft of callus hairs at the base; dorsal surface covered in hairs usually more than 1 mm long; apex deeply notched, with veins extending on either side as mucronate tips; awn spirally twisted and geniculate. Approximately 7×. (*e*) Palea almost as long as lemma, apically notched, strongly keeled at the 2 veins, with fine pubescence on veins; keels converging at base of palea, but separated by a glabrous rachilla internode. Approximately 7×.

Glossary

abaxial Located on the side away from the axis.
acuminate Tapering gradually to a point.
acute Sharp-pointed.
adaxial Located on the side toward the axis.
adnate Grown together, fused.
adventive Introduced by chance or accidental seedings.
agamous Without stamens or carpels, or abortive.
androecium The stamens considered collectively.
annual Of one season's or year's duration.
anther The pollen-bearing organ of a plant.
anthesis The period during which the flower is open.
anthocyanin Red, purple, or blue water-soluble plant pigments.
apical Concerning the apex, or tip.
apomixis Reproduction by seed formed without fusion of male and female gamets.
aristate Bearing a stiff, bristlelike awn.
attenuate Tapering gradually.
auricle A leaf appendage; adjacent to the collar between the blade and the sheath (Fig. 4).
awn A bristle, or stiff, hairlike projection; the prolongation of the midnerve or lateral nerves of the glumes, lemma, or palea.
axil The angle formed between two organs, for example between a leaf and the stem.

bearded Bearing hairs in a zone of pubescence.
biennial Living for two growing seasons (years).
bifid Two-cleft, or notched.
blade The expanded, usually flattened portion of a leaf.
bract A modified leaf subtending a flower or inflorescence; the term is sometimes used in references to the scales of a vegetative bud or other shoot structure.
bulliform cells Large, thin-walled, highly vacuolated, colorless epidermal cells present in the intercostal zones of the leaf blade, and most commonly present on the abaxial surface.

caespitose In tufts or dense clumps.
callus The hard, usually pointed base of the spikelet (in *Andropogon*) or of the floret (as in *Aristida* and *Stipa*), just above the point of disarticulation. In the spikelet, the callus is a portion of the rachis; in the floret, it is a portion of the lemma.
carpel A unit of the pistil; a simple pistil is formed from a single carpel and a compound one is formed from two or more carpels.
caryopsis A dry, hard, indehiscent, one-seeded fruit with the thin pericarp adnate to the seed coat; the characteristic grass fruit.
cauline Of the stem or arising from the culm.

chasmogamy Pollination and fertilization of open flowers.
ciliate Fringed with hairs.
cleistogamy Pollination and fertilization within closed flowers or florets. The opposite of chasmogamy.
coleoptile The cylindrical sheath protecting the embryonic shoot in a seed or seedling.
collar The abaxial side of a grass leaf at the junction of the blade and sheath.
coriaceous Leatherlike texture.
crenate With rounded teeth.
crenulate With small, rounded teeth.
culm The stem of a grass.

deciduous Falling at the end of growth or life.
decumbent Tending upward from a prostrate base.
decurrent Extending or prolonged downward, e.g., ligules decurrent (*Andropogon* Fig. 35*b*).
depauperate Diminutive, or poorly developed, often as the result of environmental stress.
dioecious Unisexual, with staminate and pistillate flowers on separate plants.
digitate Handlike; compound with members arising from one point, as in the inflorescence of *Digitaria*.
disarticulation Separation at a joint or the nodes at maturity.
distal Remote from the point of attachment.
distichous Arranged in two rows, two ranked, rows at 180° to each other.

entire Undivided, the margin continuous, without teeth or lobes.
erose Irregular and uneven, as if frayed or worn away.

fascicle A cluster, or bunch, usually of spikelets.
fertile floret A floret capable of producing fruit; may be perfect or pistillate.
flexuous Wavy, lax.
floret Each floret consists of usually 2 bracts, the lemma (lower) and the palea (upper) with the enclosed flower. The flower usually includes 2 lodicules (vestigial perianth segments), 3 stamens, and 1 pistil. Florets may be perfect, pistillate, staminate, or sterile.
fruit The ripened ovary with one or two scars where stigmas were and one scar where the ovary was attached to the plant. In grasses usually a caryopsis, with the single ovule fused to the ovary wall.

gamete A mature germ cell (pollen grain or ovule).
geniculate Abruptly bent, as in some awns (*Andropogon* Fig. 35*d*).
glabrous Without hairs or any form of projection.
gland A protuberance, depression, or appendage that secretes or appears to secrete a fluid.
glandular Glandlike or bearing glands.

glaucous Covered or whitened with a waxy bloom; the blue color of big and little bluestems.
globose Spherical or rounded.
glomerate In densely contracted, headlike clusters.
glumes The pair of bracts usually present at the base of the spikelet.
gynoecium All the female reproductive parts of a flower; pistil(s) of a flower.

hermaphrodite Bisexual; bearing male and female parts.
hirsute Bearing rather coarse and stiff hairs that are long, straight, erect, or ascending.
hispid Covered with erect, rigid, bristly hairs.
hyaline Transparent or translucent.

imperfect Unisexual flowers or florets; with either male or female reproductive structures but not both.
indurate Hard, leatherlike.
inflorescence The flowering portion of a shoot; the spikelets and the axis or branch system that supports them, the inflorescence being delimited at the base by the uppermost leaf node of the shoot.
internode The portion of the stem or other structure between two nodes.
involucre A circle, or cluster, of bracts or reduced branchlets that surround a flower or a group of flowers.
involute Rolled inward at the edges.

keel A prominent, usually dorsal, ridge, similar to the keel of a boat. Glumes and lemmas of laterally compressed spikelets are often sharply keeled; the palea in many florets has 2 keels.

lacerate Irregularly frayed or torn.
lamina The blade or expanded part of a leaf.
lanceolate Lance-shaped; relatively narrow, tapering to both ends from a point below the middle, that is, the widest portion is in the proximal half.
lemma The lower of 2 bracts enclosing the pistil and/or stamens.
ligule A membranous or hairy appendage on the adaxial surface of the grass leaf at the junction of the sheath and the blade.
lodicules Small, scalelike processes, usually two or three, at the base of the stamens in grass flowers. Lodicules are usually interpreted as rudimentary perianth segments.

membranous With the character of a membrane; thin, soft, and pliable.
monoecious Flowers unisexual, with male and female flowers borne on the same plant.
mucro A short, small, abrupt tip of an organ, for example the projection of the main nerve of a lemma.
mucronate With a mucro; having a short, sharp point at the apex.

nerve A simple vein, or slender rib, of a leaf or bract.
node The joint of a stem, the region of attachment of the leaves and roots.

oblanceolate Lance-shaped; relatively narrow, tapering to both ends from a point above the middle, that is, the widest portion is in the distal half.
obovate More or less having the shape of an egg with the broadest portion in the distal half.
ovate More or less having the shape of an egg with the broadest portion in the proximal half.

palea The uppermost of the 2 bracts enclosing the grass flower in the floret; the palea is usually 2-nerved and 2-keeled.
panicle Applied to grasses, all inflorescences where the spikelets are not sessile or individually pedicelled on the main axis.
panicoid Having a compound, racemose inflorescence.
papillate Bearing minute, nipple-shaped projections (papillae).
pectinate Narrow segments, or units, placed close together like the teeth of a comb; ciliate with large or stiff, parallel hairs.
pedicel The stalk of a single flower; in grasses, applied to the stalk of a single spikelet.
peduncle A primary flower stalk, usually applied to the stalk of a spikelet cluster in grasses.
perennial Living for more than 2 years.
perfect A flower (or spikelet) with both functional male and female reproductive structures.
perianth The "floral envelope," consisting of all the petals and sepals together.
pilose With soft, straight hairs.
pistil The female (seed-bearing) structures of the flowers, usually consisting of the ovary and one or more stigmas and styles.
pistillate Having pistils but no stamens.
pith The soft, spongy central tissue of some grass culms, composed mostly of parenchyma.
protandrous Releasing pollen before stigmas are receptive.
protogynous Stigmas becoming receptive before pollen is released.
proximal Situated next to or near the point of attachment.
puberulent Minutely pubescent.
pubescent Downy, or with fine, soft hairs.

rachilla The axis of a grass spikelet.
rachis The central axis of an inflorescence.
reduced floret A staminate or neuter floret; if highly modified, then termed a rudimentary floret.
retrorse Bent backward or downward.
rhizome An underground stem, usually with scale leaves and adventitious roots borne at regularly spaced nodes.

scaberulous With minute scabrous projections visible at 40×.
scabrous Rough to the touch, usually because of the presence of minute prickly hairs.
scarious Thin, dry, and membranous, not green, usually strawlike.
secund One-sided, all spikelets turned to one side of the rachis.
seed A ripened ovule with a single scar from the point of attachment.
serrate Saw-toothed, with sharp teeth pointing forward.
serrulate Finely serrate.
sessile Attached directly at the base, without a stalk.
setaceous Narrow, bristlelike.
sheath The tubular basal portion of a leaf that encloses the stem.
spathe Large leafy bract surrounding an inflorescence.
spicate Spikelike.
spicoid Inflorescence a raceme with all flowers sessile.
spike An inflorescence with flowers or spikelets sessile on an elongated, unbranched rachis.
spikelet The basic unit of the grass inflorescence, usually consisting of a short axis (the rachilla) bearing 2 "empty" bracts (the glumes at the basal nodes) and 1 or more florets above.
stamen The male organ of a flower, consisting of a pollen-bearing anther at the end of a filiform filament. Collectively the stamens of a flower are referred to as the androecium.
staminate Having stamens but no pistils.
sterile floret A floret incapable of producing viable male or female gametes.
stigma The part of the pistil that receives the pollen for effective fertilization.
stolon A modified horizontal stem that grows along the surface of the ground and serves to spread the plant by rooting at the nodes.
style The contracted portion of the pistil between the ovary and the stigma.
subulate Awl-shaped, tapering to a fine point from the base to the apex.

taxon Any taxonomic unit, for example genus, species, variety.
terete Cylindrical, round in cross section.
tiller A subterranean or ground level lateral shoot, usually erect, as contrasted with horizontally spreading stolons and rhizomes.
truncate Terminating abruptly as if cut off transversely.
turgid Swollen, inflated by pressure from within.
type specimen The specimen upon which the name of a plant species, subspecies, or variety is based and to which it is permanently attached.

unilateral One-sided, developing or hanging on one side.

vascular bundle A strand composed primarily of vascular tissue transversing some part of the plant; the vascular bundles in grass stems and the larger bundles in leaves consist mainly of xylem and

phloem elements and associated parenchyma and mechanical cells, partially or completely enclosed by one or two bundle sheaths.

venation The arrangement or disposition of veins.

vernation The arrangement of leaves (sepals or petals) in the unopened bud.

vestigial Rudimentary and almost completely reduced; only a remnant present.

villous Bearing long, unmatted, soft hairs.

vivipary The condition where small plantlets or bulbils dominate some or most of the spikelets. It may result from sprouting seeds still attached to the spikelet, or from vegetative proliferation of the spikelet rachilla.

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Appendix to Table 1. Coded data. A, B, C, as given in Table 1. V = variable

×*Agroelymus*	BBB–A	BBAVV	AVVVV	VVBAB	AAABV	AV–AA	VABVA	VBABV	VVAVA	BABBA
	VCBBV	BB–B–	BBACA	BBBAA	BAAAB	BB–VB	CABBA	ABABB	A–	
×*Agrohordeum*	ABB–A	BBAAA	ABAVV	CBBBB	AAAAV	AA–VA	BAAAA	–BABB	VAAVA	BAVBA
	BCCBC	BB–B–	BBACA	BVBAA	BAAAB	BB–BB	CVBBA	ABABB	A–	
Agropyron	VBVVV	BBAAA	VVVVV	VVBVV	VAAAV	VAVVV	VVVAA	–BAVV	VVAA–	BABBA
	VCVBV	BVVVV	VVACA	BVBVV	VVAVB	BB–VV	CVBBA	ABABB	V–	
Agrostis	VBVBV	BBAAA	AVVVV	CVBAB	AAAVB	B–VBV	VVBB–	VVBVA	A–V––	BAA–B
	–CCBA	BB–B–	VVVVV	BAAVV	––––V	VV–VV	CVABA	ABABA	VV	
Alopecurus	CBAB–	BBAAA	ABAVV	VBBAB	AAAVA	V––B–	VVBB–	ABBVB	A–A––	BAA––
	–CCBA	BB–B–	BBVCA	AAAAA	BBAVA	–––––	CAAAA	B––––	––	
Andropogon	CBB–A	BAAAA	AVAAV	CVBBB	AAABB	VVVB–	VVBB–	B–ABB	BAC––	AAA–B
	–CCBV	BCVB–	BBAB–	BBAAA	AAAVB	AA–BB	CAABV	ABAAV	–B	
Apera	AAAV–	BBAAA	AVACA	CABAB	AAAAB	B–VB–	BABB–	B–BBA	A–C––	BAABA
	ACCBA	BB–B–	ABACA	BBBAA	AABAA	BCBBB	CAABA	ABABA	A–	
Aristida	ABAB–	AAVB–	AA–CB	–BBBB	ABABB	AA–B–	BBBB–	A–BBA	A–C––	BAA––
	–CCVA	BB–B–	ABAB–	BBBAB	C–BBA	AA–AA	CAAAA	ABAAA	–B	
Avena	AAVBA	BBAAA	ABBBV	CBBVA	AAABV	B–BB–	AVBB–	BBBBV	A–A––	BABBA
	VCCBB	BCBCB	VAABB	BBCAA	ABVVB	BB–BB	CABBA	ABABA	V–	
Beckmannia	AAVBA	BBAAA	AAVBB	CABAB	AAAAA	B–VB–	BABB–	V–BAB	A–A––	BAA–B
	–CCBA	AB–B–	BBAVA	BAAB–	––––B	BB–AA	CAABA	ABABA	V–	

Bouteloua	VBVBA	BAAAA	AVABA	VVBAV	VVAC–	AA–BC	VBBAC	–AABV	A–AA–	BAABA
	VCVAA	BB–B–	VBVB–	BBBVC	BAAAB	BB–BV	CVABA	ABAAA	–B	
Bromus	VVVVA	BVVAV	AVVVV	VVAVB	VVAVB	VVVVV	VVBB–	BVVVA	A–V—	VAVBA
	VVBVV	BVVVV	BBVCV	VVBVV	VVAVB	BB–VB	CABBA	ABABV	V–	
Buchloë	CBAA–	BBABA	ABAVV	CVBAB	AVAC–	AA–BC	BAVVV	–AABC	A–AB–	BB—B
	BCBBB	BB–VV	BABB–	BAAB–	———B	BB–AA	CVABB	ABAVV	VV	
Calamagrostis	VBVVV	BBAAA	AVAVV	CBBVB	AAAVB	VVVB–	VVBB–	VBBBA	A–C—	BAA–A
	BCCBV	BB–B–	ABVCA	BVAAA	AVAAB	VV–AV	CVABA	ABABA	V–	
Calamovilfa	BBB–V	BAAB–	AVBAA	CBBAB	BAAC–	AV–AC	VBBB–	V–BAA	A–A—	BAA–B
	–CCBB	BB–B–	AB–B–	BABB–	———B	BCBAA	CAABA	ABAAA	–A	
Catabrosa	CBAB–	BBAAA	BBAAA	ABAAB	AAAAA	B–BB–	ABBB–	BBBBA	A–A—	BABBB
	ACBAB	BA–B–	BABB–	BABB–	———B	BB–BA	CAABA	ABABA	V–	
Cinna	ABB–A	BBAAA	BBVBB	CABAB	AAAAA	B–BAB	AABB–	BBABB	A–A—	BAA–B
	BCCBA	BB–B–	BBAB–	ABBAA	BAAAB	BCABB	CAABA	ABABA	A–	
Dactylis	ABVBA	BBAAA	BBVBB	CABBB	ABABB	B–CB–	AABB–	BBABA	A–A—	BAABA
	BCBVA	BB–B–	BBACA	ABBAA	BAAAB	BA–BB	CBABA	ABABA	A–	
Danthonia	ABVVV	VBAAA	BVAVV	CBBAB	VVVV–	AA–BC	VVBVV	VBVBV	A–AV–	BABBA
	VCCVB	BVVVV	AVAVV	BVBAV	AAABV	BB–BB	CVABA	ABAAA	–V	
Deschampsia	ABVVV	ABAAA	BVAAV	VBBAB	AAAAV	VVVAB	BABB–	VBBBA	A–A—	BABBV
	BCCBV	BB–B–	AABVV	BAAAA	VVAAB	BB–AV	CBABA	ABABA	B–	
Dichanthelium	ABVVV	VVBVV	ABVVV	VBBBB	VVAC–	AA–VV'	VVVV–	BVBBV	A–V—	BAAAB
	–CCAB	VB–VV	VAACV	BAVB–	———B	BA–AA	CBABV	ABAAA	–V	

Appendix to Table 1. Coded data. A, B, C, as given in Table 1. V = variable (continued)

Digitaria	AAAV–	BBAVA	ABVVV	BVBAB	VVAAB	AB–B–	AABAB	–AAVB	A–BBA	BAAAB		
	–VABB	VA–B–	BAAB–	BAVB–	––––B	BA–VA	CVABV	ABAAA	–B			
Distichlis	BBAV–	BA–AA	BAACA	VBBBB	AAABB	AA–BC	ABBB–	A–ABA	A–A––	BB–BA		
	ACBBB	BV–CA	BBACC	BABB–	––––B	BB–BB	CAAAC	BBAAA	–B			
Echinochloa	AAB–A	BBAAA	ABBAA	CABBB	AAB––	––B–	AABB–	BBABB	A–B––	BAAAB		
	–CCAB	AB–B–	BBACA	BAAB–	––––B	BA–AA	CBABV	ABAAA	–B			
×*Elyhordeum*	ABB–A	BBAAA	ABAVV	CBBAB	AAAAV	AA–B–	BABAA	–BABA	BAAAV	BAVBA		
	ACCBC	BB–B–	BBACA	BABBA	BBBAB	BB–BB	CVBBA	ABABB	A–			
Elymus	VBB–V	BVVVV	ABVVV	VBBVV	VVAVV	VVVAA	VVVAA	–BABA	VVABA	BABBA		
	VCVVV	BB–B–	BBACA	BBBVA	BAVAB	BB–BB	CABBV	ABABB	V–			
Eragrostis	VAVVA	BBAVA	ABA–A	VVBAB	VVAC–	AA–B–	BABB–	B–VAA	A–A––	BABBA		
	ACBBA	BB–B–	BAAV–	AABB–	––––B	BV–AB	CVABA	BBAAA	–V			
Eremopoa	AAAV–	BBAAA	BBAAA	VABAB	AAAAA	VBAB–	BABB–	B–BAA	A–A––	BAB–A		
	BCBAA	BB–B–	BBBCA	ABBB–	––––B	BB–BB	CAABA	ABABA	A–			
Eremopyrum	AAAV–	BBAAA	AVACC	CBBAB	VVAAB	AB–AA	AABAA	–BABA	A–AA–	BABBA		
	BCBBA	AB–B–	BBACA	ABB––	–––––B	BB–BB	CABBA	ABABB	A–			
Festuca	VBVVV	VBVVA	BVVVV	VVBVV	VVAVA	AA–BB	VVBB–	VBVBA	A–A––	BABBA		
	VCBVV	BB–B–	BBVVA	VVBVA	BAAAB	BB–BV	CVVBA	ABABA	A–			
Glyceria	BBVVA	BBAVA	VBVVV	VVAVB	AAAAV	B–VB–	VVBB–	BVBVA	A–V––	BABBA		
	VCBBB	VB–B–	BABCV	BVBB–	––––B	BBVBV	VVABA	AA–AA	VV			

Helictotrichon	ABAB–	ABAAA	BAAAA	CABVB	AAAAV	B–CB–	BABB–	ABBBB	A–A––	BABBA
	BCCBB	BB–B–	ABBCA	BBBAA	ABABB	BB–AB	CBBBA	ABABA	A–	
Hierochloë	BBAB–	BBAB–	ABAVV	CBBVB	AAAAA	VBAB–	AABB–	BBBAA	A–A––	BABAB
	ACCBB	AB–B–	BBACA	BBBB–	––––B	BCAAB	CAABA	ABAAA	V–	
Hordeum	AVVVV	BVAAA	ABVVV	VVBAB	AAABV	AVVVV	VABAA	–BVVV	A–VVV	VAAVA
	BCVBV	BV–V–	BBACA	BVVAA	VVVAB	BV–VV	CABBA	ABABV	VV	
Koeleria	ABABA	ABVB–	AVACC	BBBAB	BBABB	AA–BC	BABB–	ABBBA	A–A––	–ABBA
	BCCBA	BB–B–	BBAV–	ABB––	––––B	BB–AB	CAABA	ABABA	A–	
Leersia	ABB–A	BBAAB	BBCVV	CABBA	–BABA	AB–B–	BABB–	B–BB–	A–A––	BAA–B
	–A–––	–––––	BAACA	ABBB–	––––B	BCABB	CAABA	ABAAA	–B	
Lolium	AVVVV	BBAAA	ABVVA	VBBVV	AAAAV	AV–VA	VABAA	–BAVA	A–AA–	BABBA
	VBVAB	B––CA	BVVCA	BAVVA	VAAAB	BB–BB	CAABA	ABABA	V–	
Muhlenbergia	BBVVV	BVVVV	VVAVV	VVBVV	AAAVV	VVVB–	VVBB–	VVBVA	V–V––	BAV–B
	–CVVV	VV–B–	VBVB–	BBBVV	V–AVB	BVVVV	CVABV	ABAVA	–V	
Munroa	AAAA–	ABVB–	BBABB	CABAA	BAAC–	AA–AB	BAAB–	ABBBA	A–A––	BABBA
	ACBBA	BB–B–	AABB–	ABBAA	BAAAB	BB–BB	CAABA	VBAAA	–A	
Oryzopsis	ABVBV	VVVAA	AVVVV	VVBVV	VAAVV	VVVVV	VVBVV	VVBVA	A–C––	BAAVV
	–CVBB	VVVVV	VBACV	BVCVA	V–AVB	BA–VV	CVAVA	ABVBA	VV	
Panicum	VVVVV	BBVAB	ABVVV	VABVV	VVAC–	VVVB–	VVBB–	B–BVB	V–V––	BAAAB
	VCCVB	AVVCV	BAACA	BAVB–	––––B	BA–VA	CVABB	ABAAA	–B	
Phalaris	VVVVV	BBAAA	ABVVV	VBBAA	AAAVB	B–BVB	VVBB–	ABBVA	A–A––	BAAAB
	–CCBA	AB–B–	BAACA	BBBB–	––––B	BCAAB	CAABA	ABABA	B–	

Appendix to Table 1. Coded data. A, B, C, as given in Table 1. V = variable (concluded)

Phleum	VBVBA	BBAAA	ABABB	CBBAB	AAAAV	B–BVB	AABB–	ABBBA	A–A––	BAA–B
	–CCBA	AB–B–	BABCA	BBAB–	––––B	BCAAB	CVABA	ABABA	A–	
Phragmites	BBB–B	BBAAA	ABCAA	AABAB	AAABB	BB–B–	ABBB–	B–BAA	A–C––	BABBA
	BCBAB	BB–V–	BBAV–	BABB–	––––B	BB–AA	CBABB	ABAAA	–B	
Poa	VVVVV	VBAAA	BVAVV	VVBAB	VVAVV	VVVB–	VVBB–	V–BVA	A–A––	BABBA
	VCCBV	BB–VV	VVACA	VVBB–	––––B	BB–AV	CVABA	ABABA	A–	
Polypogon	AAVBA	BBAAA	ABABB	CABAB	BAABB	B–VB–	BABB–	A–BBB	A–C––	BAA–B
	–CCBB	BB–B–	BB–V–	BAAAA	AAAAB	BA–AA	CAABA	ABABA	B–	
Puccinellia	ABAV–	BBAAA	AVABA	CBBAB	AAAAA	VB–B–	BVBB–	BBBBA	A–A––	BABBA
	ACBVB	BB–B–	BABCA	BABB–	––––B	BB–BB	CAABA	A		
Schedonnardus	ABAV–	AABBA	BVAAA	CABAB	AAAAA	B–AB–	BABB–	BBABB	A–A––	BAA–B
	–CBBA	BB–B–	BBAB–	BBBB–	–––––B	BB–BB	CAABA	ABAAA	–A	
Schizachne	BBB–A	BAAAA	ABAAA	CBAAB	AAAAB	AA–AB	BBBB–	BBABA	A–A––	BABBA
	BCBBB	BB–B–	ABACB	BBBAA	AAAAB	BB–BB	CAABA	ABAAA	–A	
Schizachyrium	ABB–A	BAAAA	BVABB	CABAB	AAABA	AB–B–	BAAAC	–BABB	BAV–A	AAA–B
	–CCBV	BCAB–	BBBB–	BBAAA	AAABA	––––B	CBABB	ABAAA	–B	
Scolochloa	BBB–A	BBAAA	ABBAV	CBBAB	AAAAB	B–CAB	AVBB–	BBABA	A–A––	BABBA
	BCCBA	BB–B–	BBACA	BABB–	–––––B	BB–BB	CABBA	ABABA	A–	
Secale	AAV–B	BBAAA	ABABV	BBBBA	AAABB	AA–AA	AABAA	–BABB	A–ABA	BAB–A
	BCBBC	BB–B–	BBACA	ABBAB	ABBAB	BCBBA	CABBA	ABAAB	A–	

Setaria	AAVBA BVAAA	ABVVV CABVB	VAAC- AV-B-	VABB- A-BBB	VVB-- BAAAB
	VCVVB AB-CA	BAACA BACB-	----B BB-AA	CVABV ABAAA	-V
Sitanion	ABAV- BBVBA	ABACC CBBAB	VBAAA AA-AA	VBBAA -BABA	A-ABA BABBV
	VCCBC BB-B-	BBACA BBBBA	BABAB BB-BB	CABBA ABABB	A-
Sorghastrum	BBB-A BBAAB	AVABB CVBAB	VVABA B-AAB	BBBB- BBBBB	A-B-- AAA-B
	-CCBB BCBCA	BBBB- BBAAA	AAABA ----B	CABAC ABAAB	-B
Spartina	BBBVA BBAB-	ABVVA CBBAB	AAAC- VV-B-	VBBBC -AAVB	A-AA- BAA-B
	-CCAA BB-B-	BABB- ABAB-	----B BBBBV	CVAAB VBAAA	-A
Sphenopholis	ABVBA BBAAA	ABABB CVBVB	AVAVB VVVB-	VVBB- V-BBB	A-A-- BAVVA
	VCCAA AB-B-	BAAB- BBBB-	----B BB-AB	CAABA ABABA	A-
Sporobolus	AVVVA BAAVA	AVAVA CVBAB	VVAC- AA-BV	VVVB- V-BVA	A-A-- BAA-B
	-CCVA BB-B-	BBBB- AVBB-	----B BVVVA	CVVVA ABAAV	-V
Stipa	ABVBA BVVAV	AVAVA CVBAV	VVAVV V--VV	BABB- V-BVA	A-C-- BAA-B
	-CCBB BVVVV	VBACV BBCAA	C-BBB VA-VV	CVABA ABVBV	V-
Torreyochloa	CBAB- BBAAA	AAACC BBBAB	AAABB B-BBB	BVBB- BBBBA	A-A-- BABBA
	BCBAB BB-B-	BABCA BBBB-	----B BB-BB	CVBBA ABABA	A-
Trisetum	ABVBA BBVAV	ABVVV VVBVB	VVVVB VVVB-	AABB- V-BBA	A-A-- BABBA
	VCVVB BB-B-	VBAVV ABBVV	VVAVB BVBAV	CAVBA ABABA	A-
Triticum	AAB-A BBVAV	ABBVV BABAB	AVAAB AB-AA	BAVAA -BABA	BAAA- BABBA
	BCBBA BCVCV	BBACV VVBAA	VAVAB BB-BB	CABBA ABABB	A-
Vulpia	AAAA- BBVAA	CAAVA CBBAB	VVABB AA-B-	BBBVA ABBBA	A-AA- BABBA
	BCBAV BB-B-	BBACB BBBAA	BAAAB BB-BB	VVABA ABABA	A-
Zizania	AAB-V BBAAB	ABBAA CABBB	AAAAB B-CB-	AABB- B-BAB	A-B-- BB--B
	-A--- -----	BBACA BBBAA	C-BAB BA-BB	DAABA ABAAA	-A

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